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AUTHOR Cosler, Norma, Ed.
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ABSTRACT

THis is one of eighteen sets of individualized mathematics problems developed by the Oregon Vo-Tech Math Project. Each of these problem packages is organized around a mathematical topic and contains problems related to diverse vocations. Solutions are provided for all problems. Problems in this volume concern use of decimals and are related to the fields of real estate, clerical work, auto mechanics, aviation mechanics, welding, diesel mechanics, machine tools, drafting, industrial mechanics, electricity and hydraulics, electronics, forest products, wood products, forestry, nursing, marketing, food processing, agriculture, and wastewater technology. Several of these vocational sections in this package include problems involving money computations; computation of ratios of two decimal fractions is stressed in others. (SD)

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I
L INDIVIDUALIZED
LEARNING
S SYSTEMS

Individualized Math Problems in

Decimals

Oregon Vo-Tech Mathematics Problem Sets

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SE 020 633

STATE DEPARTMENT
OF EDUCATION
942 Lancaster Drive, NE
Salem, Oregon 97310
JESSE FASOLD
Superintendent of
Public Instruction

Project Director:
Dell Swearingen
Linn-Benton Community College

Ex-Director:
Galen Nielsen
Linn-Benton Community College

Writers:
John Anderson
Southwestern Oregon College

Ted Boyll
Treasure Valley Community College

Richard Claudson
Treasure Valley Community College

Bud Cook
Lane Community College

Kay Elling
Chemeketa Community College

Gene Enfield
Sprague High School

Bobby Finnell
Portland Community College

Don Gallagher
Central Oregon Community College

Harold Hauser
Blue Mountain Community College

Al Hendricksen
Marshfield High School

Editor:
Norma Cosler

Consultant:
Jerry Ludlow
State Department of Education

Writers:
Frank Holliday
Rogue Community College

Woody LaSueur
Canby High School

Henry Lind
Portland Community College

Mike Morgan
Linn-Benton Community College

Harrison Platt
Clackamas Community College

Bill Rino
Roseburg High School

Merlin Salter
Chemeketa Community College

Ken Thomason
Umpqua Community College

Frank Weeks
Mt. Hood Community College

Assistant Editors:
Bob Mack
Mike Long

Graphic Artist:
Rose Davis

Typists:
Tina Hale
Shelley Mack

Individualized Learning Systems

MATHEMATICS

Decimals

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A. Problems with solutions.

The formula necessary to solve capitalization problems is (A)(R) = I Which means: (Amount or Value of capital)(Rate per year) = (Income per year). There qre two equations equivalent to this one. See if you agree.

$I \div A = R$ or $A\overline{)I}^{R}$

$I \div R = A$ or $R\overline{)I}^{A}$

note: In this unit we will use rate as a decimal, in other units it may be written as a percent. Income will also be called Interest.

1. A farm sold for $28,500 and the total brokerage fee received by the broker was $1140. What was the brokerage fee rate?

   Solution:

   Amount of capital $28,500

   Income $1140

   $I \div A = R$

   $\$1140 \div \$28,500 = .04$

2. If the annual interest charge is $125 and the rate is .05 per year, what is the amount of money being owed?

   Solution: Amount of capital

   $I = \$125$
   $R = .05$

   $I \div R = A$

   $\$125 \div .05 = \$2500$

3. A loan on a balance of $7500 has an interest rate of .085. What would be the income?

   Solution: $(A)(R) = I$

   $(\$7500)\ (.085) = \$637.50$

B. Problems without solutions.

4. Mr. Morgan pays $22.50 interest each month on an annual interest of 0.065. What is the principal amount owed?

5. Ira Larsen's annual taxes are $1120 on an assessed value of $62,500. What is his tax millage rate?

6. Mr. Curtis owns an apartment with a gross income per month of $1400. The yearly expenses are $4350. The interest rate is .09. What is the value of his building?

B. Problems without solutions.

7. Elizabeth Smith pays $18.30 interest each month on an annual interest rate of .0725.
   a) What is the principal amount owed?
   b) What is the bi-monthly income?

8. A contract has a yearly interest rate of .075 and the semi-annual interest charge is $650. What is the principal amount owed?

9. A savings account has a balance of $12,575 and pays a yearly income of $635. What is the annual rate paid?

B. Problems without solutions.

10. Samuel Laver's annual taxes are $720 on an assessed value of $32,600. What is his tax millage rate?

11. If the monthly interest is $108 on a mortgage with an unpaid balance of $18,000, what is the annual rate of interest?

12. John Silver owes $12,600 on a contract. His interest is $384 due every four months. What is his annual interest rate?

B. Problems without solutions.

13. If the taxes on a home are $359.48, based on a millage rate of 0.0655, what is the assessed value of the property?

Complete solutions to B problems.

4. ($22.50/month)(12 months/year) = $270/year

(A)(R) = I

(A)(.064) = $270.00

A = $270.00/.065

= $4153.85

5. ($62,000)(R) = $1120

R = $1,120/$62,000

= 0.018

= 18 mills

6. yearly income = ($1400/month)(12 months/year) = $16,800/year

$16,800 - $4350 = $12,450 equals net income

(A)(R) =I

(A)(.09) = $12,450

$$A = \frac{\$12,450}{.09}$$

= $138,333.33

7. a) yearly interest = ($18.30/month)(12 months/year) = $219.60

(A)(R) = I

(A)(.0725) = $219.60

A = $219.60/.0725

= $3028.97

b) ($18.30/ month)(2 months) = $36.60

8. yearly interest = ($650)(2) = $1300

(A)(R) = I
(A)(.075) = $1300
A = $1300/0.075
= $17,333.33

Complete solutions to B problems.

9. (A)(R) = I

($12,575)(R) = $635

R = $635 / $12,575

= .05

10. (A)(R) = I

($32,600)(R) = $720

R = $720/$32,600

= .022

= 22 mills

11. yearly interest = ($108/month)(12 months/year) = $1296.00

(A)(R) = I

($18,000)(R) = $1296.00

R = $1296.00/ $18,000.00

= .072

12. yearly interest = (3)($384) = $1152

(A)(R) = I

($12,600) (R) = $1152

R = $1152/$12,600

= .091

13. (A)(R) = I

(A)(.0655) = $359.48

A = $359.48/.0655

= $548.11

A. Problems with solutions.

1. Express the following fractions in millage decimal terms.

a) 42 1/2 mills b) 29 2/3 mills c) 1 1/4 mills d) 206 mills

e) 1/10 of 1 mill.

Solution:

a) 0.0425 b) 0.02967 c) 0.00125 d) 0.206 e) 0.001

2. If the tax rate is 65 mills on property assessed at $5800

a) What are the annual taxes on the property?

b) If sold on April 15 and the fiscal tax year is July 1 to June 30, what is the value of the pre-paid taxes?

Solution:

a) (A)(R)=I

($5800)(0.065) = I

$377 = I

b) April 15 to June 30 is 2 1/2 months

Taxes per month = ($377/~~year~~) (1~~year~~/12months)

= $31.42/ month

($31.42/~~month~~)(2.5 ~~months~~) = $78.55

3. The assessed value on a home is $15,000 and the assessed value of the lot is $2500. When the district was re-appraised, the lot assessment value was raised $500. If the millage rate increased 5 mills from its present 0.005 millage rate, what was the total increase in tax on the house and lot?

Solution:

Original assessed value = $15,000 + $2,500

= $17,500

Original tax = ($17,500)(0.005)

= $87.50

A. Problems with solutions.

3. continued.

Newly assessed value = $15,000 + $2,500 + $500

= $18,000

New tax = ($18,000)(0.010)

= $180.00

Difference = $180.00 - $87.50 = $92.50

B. Problems without solutions.

4. A property has an assessed value of $7000 and a tax rate of $3.17 per $100. What are the annual real property taxes?

5. The assessed value of some property is $5630. The millage rate is 45 mills. What are the assessed taxes?

6. A lot 90 feet wide and 120 feet deep has an assessment of $30 per front foot. The house on the lot was assessed at $25,500. What was the total annual tax if the rate was 42 1/2 mills?

B. Problems without solutions.

7. The millage rate of 50 mills is to be applied to a home assessed at $8750. What are the assessed taxes?

8. Property assessed at $5800 has a fire protection tax rate of $1.55 per hundred.

   a) What are the annual taxes?

   b) If the property is sold March 1 and taxes for the calendar year had not been paid, what is the tax credit to the buyer?

9. A) Express 26 1/2 mills in decimal equivalency.

   B) Express 136 mills in decimal equivalency.

B. Problems without solutions.

10. A lot 85 feet wide and 140 feet deep has an assessment of $20 per front foot. The house on the lot was assessed at $17,800. What was the total annual tax if the rate was 35 mills?

11. A property has an assessed valuation of $28,195. The tax rate is $29 per $1000. What are the real property taxes?

12. A lot with an assessed value of $2500 has a millage rate of 50 mills. What is the monthly tax expense?

B. Problems without solutions.

13. A lot assessed at $4800 and a house assessed at $27,000 have a millage rate of .04

a) What would be the taxes on the lot?

B) What would be the taxes on the entire property?

14. A property has a tax rate of 52 1/8 mills. Express the tax rate as a decimal.

Complete solutions to B problems.

4. The taxes are $3.17 per $100 assessed value

$$\frac{\$7000}{\$100} = 70$$

($3.17)(70) = $221.90

5. (A)(R) =I

($5650) (0.045) =I

$254.25 =I

6. Assessed value = $25,500 + (90 ~~ft~~)($30/~~ft~~)

= $25,500 + $2700

= $28,200

(A)(R) =I

($28,200)(0.0425) = I

$1198.50 = I

7. (A)(R) =I

($8750)(0.050) =I

$437.50 =I

8. a) The taxes are $1.55 per $100 assessed value

$$\frac{\$5800}{\$100} = 58$$

(58)($1.55) = $89.90

b) Jan 1 to Mar 1 is 2 months

Taxes per month = ($89.90/year)(1 year/12 months)

= $7.49/month

Tax credit = (2 months)($7.49/month)

= $14.98

Complete solutions to B problems.

9. a) 0.0265

b) 0.136

10. Total assessed value = \$17,800 + (85~~ft~~)(\$20/~~ft~~)

= \$17,800 + \$1,700

= \$19,500

Total annual tax = (\$19,500)(0.035)

= \$682.50

11. The tax rate is \$29 per \$1000 assessed value

$\frac{\$28,195}{\$1000} = 28.195$

(28,195)(\$29) = \$817.66

12. Taxes per year = (\$2500)(0.050)

= \$125

Taxes per month= (\$125/~~year~~)(1~~year~~/12 months)

= \$10.42/month

13. a) Taxes on the lot = (\$4800) (0.040)

= \$192.00

b) Total assessed value = \$4800 + \$27,000

= \$31,800

Total property taxes = (\$31,800)(0.040)

= \$1,272.00

14. 1/8 = .125

0.052125

A. Problems with solutions.

1. On May 10 you sold a home for $25,500. The tax rate was $25 per thousand dollar value. What sum of money would you receive when dividing with the buyer? (Note: Fiscal year is July 1 to June 30. Also, use 30 day/month and 360 days/year.)

   Solution: First, find the total years taxes

$$(\$25{,}500)\left(\frac{\$25}{\$1000}\right) = \$637.50$$

   Then find how much tax per day

$$\frac{\$637.50}{360 \text{ day}} = \$\ 1.77/\text{day}$$

   Days left in fiscal year :

   20 in May
   +30 in June
   50 total days

   So, the buyer owes you (50 days)($1.77/day) = $88.50

2. On October 8, you purchased a home valued at $25,000. The taxes of $600 for the fiscal year of July 1 to June 30 are not paid . The fire insurance policy is for one year and was written on January 5th at a premium cost of $90. The seller has a public liability policy which the buyer is to purchase. The policy was issued March 15th for one year at a cost of $24. Prorate the taxes and Insurance. (Hint: Work three separate problems.)

   Solution:

   First the taxes : Taxes per year = $600

   Taxes per day = $600/360 days

   = $1.666

   Days in the fiscal year that have past
   30 days in July
   30 days in August
   30 days in Sept.
   8 days in Oct.
   98 total days

   Taxes due the buyer from the seller are (98 days)($1.666/day) =$163.27

A. Problems with Solutions

2. continued

Next, the fire insurance

Cost per year is $90
Cost per day = $90/360 days = $0.25/day

Number of days before policy expires

	22 days in Oct
	30 days in Nov
	30 days in Dec
+	5 days in Jan
Total	87 days

Amount owed the seller = (87 days)($0.25/day)
= $21.75

Last, the liability insurance

Cost per year is $24
Cost per day = $24/360 days = $0.066/day

Number of days before policy expires

	year	months	day	
		15		
	~~1~~	~~3~~	15	
-		10	8	
		5	7	= 157 days

Amount owed the seller = (157 days)($0.066/day)
= $10.36

So, total prorate is	$163.27
	- 10.36
	$152.91
	- 21.75
Seller pays buyer	$131.16

B. Problems without solutions.

3. A furnished apartment sold Jan. 15 for $32,000. The real estate tax amounted to $300 for the fiscal year July 1 to June 30 and is paid in full. The personal property tax is $52.80 for the calendar year Jan. 1 to Dec. 31 and is not paid .

   a) What is the unused portion of the real property tax? Who will have to pay what?

   b) What is the unused portion of the personal property tax? Who will have to pay what amount?

4. A house was sold March 1. The taxes had been paid in full for the calendar year.

   a) How many months are charged to the buyer?

   b) What is the dollar value if the taxes are $627.96 semi-yearly?

B. Problems without solutions.

5. The taxes on a home last year were $894 and the transaction is closed April 15. The fiscal year is from Feb. 1 to Jan 31. Taxes become a lien at the beginning of the tax year but are not payable until May 15. What is the value of the earned taxes? After the taxes are paid on May 15, what will be the value of the pre-paid taxes?

6. A fire insurance policy has an unused portion of 7 months 23 days. The cost of the one year was $90.

   a) What is the value of the prepaid portion?
   b) What is the value of the earned premium?

B. Problems without solutions, continued.

7. On Feb. 12, 1975 you purchased a fire insurance policy for a 5 year period. The rate was $1.10 per thousand for the five years. You also had your home insured for $29,200. You sold the home April 10, 1977. What amount of money would you receive from the buyer when you sold your home?

8. You buy fire insurance for your home which is worth $24,500. The yearly rate is $.16 per hundred. When buying a 5 year policy you need only to pay 4 times the annual rate.

   a) What would be the cost of your policy for a 5 year period?

   b) If you sold the home with 1 year 4 months 2 days remaining, what would you receive from the buyer?

B. Problems without solutions.

9. A fire insurance policy purchased March 1, 1975 at a cost of $288 for three years was sold Nov. 15, 1975. What is the value of the unused portion?

10. The tax year is Jan 1 to Dec. 31. The taxes of $252 are paid in full and the property is sold April 15th.

    a) What is the value of the prepaid portion?

    b) If the fiscal tax year was July 1 to June 30, what is the value of the prepaid portion?

11. A large apartment complex containing 68 units sold on the 5th of the month. What is the value of the prepaid rent for the following rental schedule?

    a) 22 units @ $150 per month. All rent paid except for one empty unit. Rent is paid from first to end of month.

    b) 10 units @ $185 per month. All units rented and rent is paid. Rent is paid from 15th to 15th of the following month.

    c) 36 units @$50 per week - rent is prepaid for 3 days from date of closing. All rent is paid on 32 units and 4 units are vacant.

B. Problems without solutions.

12. On March 15, Mrs. Potter sold her home. The taxes on the property for the calendar year are $347. The taxes have not been paid.

    a) What credit will Mrs. Potter give to the purchaser for the period of time she occupied the property?

    b) What would the charge to the buyer be if the taxes had been paid and the fiscal tax year was July 1 to June 20?

13. A 5 year fire insurance policy is purchased Sept. 15, 1973 and sold on March 15, 1975.

    a) What is the prepaid portion?

    b) What is the value of the prepaid portion if the insurance rate is 43¢ per $100 per year and the home is insured for $27,300?

B. Problems without solutions.

14. The tax year is Feb 1 to Jan 31. The tax of $375 is paid in full. The property sold Oct. 15.

a) What is the value of the prepaid taxes?

b) What is the value of the earned taxes?

Complete solutions to B problems.

3. a) Amount of tax per month is $300/12 months = $25/month

Time remaining in fiscal year is

	1/2 month in Jan.
	1 month in Feb.
	1 month in Mar.
	1 month in Apr.
	1 month in May
+	1 month in June
	5 1/2 months total

(5 1/2 months) ($25/month) = $137.50 will be payed the seller by the buyer.

b) Amount of tax per month is $52.80/12 months = $4.40/ month
Time buyer will pay tax is Jan 1 - Jan 15 = 1/2 month
Amount to be payed to buyer = (1/2 month)($4.40/month) = $2.20

4. a) March 1 to Dec 31 = 10 months

b) Tax per year = (2)($627.96) = $1255.92

Tax per month = $1255.92/12 = $104.66/month

Dollar value = (10 months)($104.66/month) = $1046.60

5. Tax per month = $894/12 months = $74.50/ month

Time from beginning of fiscal year to tranaction date is 2 1/2 months

Earned taxes = (2 1/2 months)($74.50/month) = $186.25

Time from transaction date to end of fiscal year is 12 months - 2 1/2 months = 9 1/2 months

Prepaid taxes = (9 1/2 months)($74.50/month) = $707.75

6.

a) Cost per day = $90/360days = $0.25/day

Number of prepaid days = (7 months)(30day/month) + 23 day = 233 days

Prepaid portion = (233 days) ($0.25/day) = $58.25

b) Earned premium = $90 - $58.25 = $31.75

Complete solutions to B problems.

7.

	Year	Month	Day	
	1975	2	12	
+	5			(five year policy)
	1980	2	12	
	1977	4	10	(selling date)
	2	10	2	

Rate: \$1.10 per thousand for 29000 =(29)(\$1.10 = \$31.90

.22 (figure 11¢ for 100)

\$32.12 total cost for 5 years

Cost per day \$32.12 ÷ 1800 (360 days per year for 5 years) = \$.018

2 years = 720 days
10 months = 300 days
2 days
1022 total days

(1022 days) (\$.018/day) = \$18.40
You would receive \$18.40 from the buyer when he sold your home.

8. a) (4) $\left(\frac{\$0.16}{100}\right)$ = \$0.64/100

(24500)(\$0.64/100) = \$156.80

b) Time left = (1 year) (360 days/year) + (4 months) (30 days/month) +

+ 2 day = 482 days

Cost per day = \$156.80 /360 days = \$0.436/day

Money returned = (\$0.436/day)(482 days) = \$210.15

9.

	1974	3	1
+	3		
	1977	14	31
	~~1978~~	~~3~~	~~1~~
-	1975	11	15
	2	3	16

Complete solutions to B problems, continued.

9. continued. 3 year cost is $288

cost per year =$288/3

= $96/year

Cost per day = $96/year / 360 days/year = $.27/day

3 months = 90 days so time unused is 2 years 106 days.

Value of unused portion =

(2 years) ($96/year) + (106days)($.27/day)

= $192 + $28.62 = $220.62

10. a) April 15 to Dec 31 = 8 1/2 months

($252/year) ÷ (12 months/year) = $21/month

($21/month)(8.5 months) = $178.50

b) April 15 to June 30 = 2 1/2 months

($21/month)(2.5 months) = $52.50

11. a) (21 units) ($150month/unit) = $3150

($3150/ month) ÷ (30 days/month) = $105/days

($105/day) (25 days) = $2625

b) (10 units)($185 per month/unit) = $1850/month

($1850/month) ÷ (30 days/month) = $61.667/day

(10 days)($61.667/day) = 616.67

c)

(32 units)($50 per week/unit) = $1600/week

($1600/week) ÷ (7 days/week) = $228.57/day

(3 days)($229.57/day) = $685.71

Total prepaid rent = $2625.00
$ 616.67
$ 685.71
$ 3927.38

Complete solutions to B problems, continued.

12. a) ($347/year) ÷ (12 months/year) = $28.92/month

(2 1/2 months) ($28.92/month) = $72.30

b) (3 1/2 months) ($28.92/month) = $101.22

13. a)

1973	9	15
+ 5		
1978	9	15
1975	3	15
3	6	0

answer : 3 years 6 months.

b) ($.43) (273) = $117.39 cost per year.

(3 1/2 years) ($117.39/year) = $410.87

14 a) October 15 to Jan. 31 is 3 1/2 months

($375/year) ÷ (12months/year) = $31.25/month

($31.25/month) (3 1/2 month) = $109.38

b)
$375.00
-$709.38
$265.62

A. Problems with solutions.

1. A house 130' 6" by 30' and 24' high is to be built. One contractor bid $9.20 per square foot of floor space. A second contractor bid 40¢ per cubic foot. Which is the lower price and by how much?

Solution: Floor area = (130'6")(30')

= (130 1/2')(30')

= 3915 sq ft

Volume = (3915 sq ft)(24')

= 93,960 cu ft

Price on volume bid = (93,960 ~~cu ft~~)($.40/~~cu ft~~) = $37,584

Price on square ft bid = (3915 ~~sq ft~~)($9.20/~~sq ft~~) = $36,018

$1,566

So, it would cost less to take the square foot bid by $1,566.

2. The dimensions of a house are 30' by 45'.

a) How many square feet are in the house?

b) What is the price per square foot if the value of the house is

Solution: a) 30' by 45' =1350sq ft (ans.)
b) $31,750 ÷ 1350 sq ft = $23.52/ sq. ft.

3. The cost per square foot of a building was $12.93. How many square feet were there in this building if the total cost was $32,500?

~~$~~32,500 ÷ ~~$~~12.93/sq ft = 2513.53 sq ft. (ans.)

4. A lot measuring 100 ft by 108.9 feet would be what portion of an acre?

Solution:

(100) (108.9) = 10,890 sq ft

10,890 ~~sq ft~~ ÷ 43560 ~~sq ft~~/acre = 0.25 acre

B. Problems without solutions.

5. 5" is what decimal part of a foot?

6. A basement 8 feet deep is to be dug for a house 40' by 55'. How many cubic yards of dirt need to be removed?

7. A building measuring 33'6" by 42'6" would contain how many square feet?

8. A block measures 800 ft square. The cost of constructing a cement curb around the block would be $1.75 per lineal yard. What would the curb cost?

B. Problems without solutions

9. A parcel of land 250' by 750', at $950 per acre, would cost how much?

10. A house 45' by 142'6" and 15' high is to built. One contractor bid $10.40 per square foot. A second contractor bid $0.65 per cubic foot. Which contractor has the lowest bid and by how much?

11. How many acres are in 1/50 of a section?

12. A plot of ground containing a 2 1/2 acres has 300 front feet. What is the depth of the property?

B. Problems without solutions.

13. An office 18 feet by 27 feet rents for $125 per month. What is the annual rent per square foot?

14. A sidewalk 45 feet long, 4 feet wide, and 4 inches thick is to be constructed. At 65¢ per cubic foot, what would the sidewalk cost?

15. What is the cost of excavating a basement 45 feet long, 30 feet wide and 8 feet deep at 35¢ a cubic foot?

B. Problems without solutions.

16. How many 50' by 100' lots are in an acre?

17. A roof measures 200 feet by 48.625 feet. How many roofer squares will need to be applied. (note: 100 sq ft is a roofer square.)

18. A subdivision containing 14 building lots with a width of 75 feet each, desires to make $33,750 from the sale of the lots. He also wishes to keep two lots for himself. What must be his sale price per front foot of the lots he sells?

B. Problems without solutions.

19. What is the value of a building containing 4225 sq. ft. at $9.20 per square ft.?

20. How many 100' by 120' lots are in one acre?

21. If a room 12'6" by 15' is to be carpeted with carpet costing $7.30 per square foot, what will be the cost?

22. An acre of land is 871.2 ft. deep. What is the width?

B. Problems without solutions.

23. A lot measuring 25 feet deep and 100 feet wide is selling for $1.40 per front foot. What is the selling price?

24. A parcel of land measuring 200 ft by 326.7 ft sells for $6,200 per acre. What is the approximate sale price?

Complete solutions to B problems.

5. 5" ÷ 12 in/ft = 0.417 ft

6. Volume = (40')(55')(8') = 9000 cu ft

(9000 ~~cu ft~~)(1cuyd/27 ~~cuft~~) = 333.3 cu yds

7. Area = (length)(width)

= (33 1/2')(42 1/2')

= 1423.75 sq ft.

8. (800 ft/~~side~~)(4 ~~sides~~) = 3200 ft

(3200 ~~lineal ft~~)(1 lineal yd/3 ~~lineal ft~~) = 1066.667 lineal yds

(1066.667 ~~lineal yds~~)($1.75/~~lineal~~ yd) = $1866.67

9. (250')(750') = 187,500 sq ft

(187,500 ~~sq ft~~)(1 acre/43,560 ~~sq ft~~) = 4.30 acres

(4.30 ~~acres~~)($950/~~acre~~) = $4089.19

10. Surface area = (45')(142 1/2') = 6412.50 sq ft

Volume = (6412.50 sq ft)(15') = 96187.50 cu ft

Price on cu ft bid = (96,187.50 cu ft)($0.65/cu ft) = $62,521.88

Price on square ftbid= (6412.50 ~~sq ft~~)($10.40/~~sq ft~~) = $66,690.00

So, it is cheaper by $4168.12 to use the cu ft bid.

11. $\left(\frac{640 \text{ acres}}{\text{section}}\right)\left(\frac{1}{50}\right)$ = 12.80 acres

Complete solutions to B problems.

12. (2 1/2 ~~acres~~)(43,560 sq ft/~~acre~~) = 108,900 sq ft

$$\frac{(108{,}900\ \cancel{\text{sq ft}})}{300\ \cancel{\text{sq ft}}} = 363 \text{ ft}$$

13. Surface area = (18')(27') = 486 sq ft

Cost per year = ($125/~~month~~)(12 ~~months~~/year)

= $1500/year

$$\frac{\$1500/\text{year}}{486 \text{ sq ft}} = \$3.09 \text{ per sq ft per year}$$

14. Volume = (45')(4')(1/3')

= 60 cu ft

Cost = (60 ~~cu ft~~)($0.65/~~cu ft~~)

= $39

15. Volume = (45')(30')(8')

= 1080 cu ft

Cost = (10,800 ~~cu ft~~)($0.35/~~cu ft~~.)

= $3780

16. Area per lot = (50')(100') = 5000 sq ft/lot

$$\frac{43{,}560\ \cancel{\text{sq ft}}/\text{acre}}{5000\ \cancel{\text{sq ft}}/\text{lot}} = 8.71 \text{ lots/acre}$$

17. Area of roof = (200')(48.625')

= 9725 sq ft

$$\frac{9725\ \cancel{\text{sq ft}}}{100\ \cancel{\text{sq ft}}/\text{square}} = 97.25 \text{ squares}$$

Complete Solutions to B Problems

18. (12 ~~lots~~)(75 front ft/~~lot~~) = 900 front ft

$$\frac{\$33,750}{900 \text{ front ft}} = \$37.50/\text{front ft}$$

19. (4225 ~~sq ft~~)($9.20/~~sq ft~~) = $38,870

20. Area of a lot = (100')(120') = 12000sq ft/lot

$$\frac{(43560 \text{ sq ft/acre})}{12,000 \text{ sq ft/lot}} = 3.63 \text{ lots/acre}$$

21. Area to be covered = (12.5')(15') = 187.50 sq ft

Cost = (187.50 ~~sq ft~~)($7.30/~~sq ft~~) = $1,368.75

22. $$\frac{43,560 \text{ sq ft}}{871.2 \text{ ft}} = 50.0 \text{ ft}$$

23. Selling price = (100 ~~ft~~)($1.40/~~ft~~) = $140.00

24. Area = (200')(326.7')
= 65,340 sq ft

$$\frac{65,340 \text{ sq ft}}{43,560 \text{ sq ft/acre}} = 1.50 \text{ acres}$$

Sale price = (1.5 ~~acres~~)($6,200/~~acre~~)
= $9,300.00

A. Problems with Solutions

1. Sales for the day in one department of a notions store were as follows: $26.50, $0.76, $12.20, $3.56, $20.09, $8.80, $5.60, $3.76 and $4.20. Find the total of all sales that were less than $10.00 and the total sales for the day.

Solution:

It is necessary to add all numbers less than $10.00. Remember to keep the decimals in a vertical line.

$$\begin{array}{r} \$\ .76 \\ 3.56 \\ 8.80 \\ 5.60 \\ 3.76 \\ 4.20 \\ \hline \$26.68 \end{array}$$

For the second part, add $26.68 to all those values over $10.00.

$$\begin{array}{r} \$26.68 \\ 26.50 \\ 12.20 \\ 20.09 \\ \hline \$85.47 \end{array}$$

2. The monthly telephone bills for the Banes Optical Company for 6 months were: $47.16, $59.25, $63.75, $43.50, $59.25 and $87.16. What was the average monthly telephone bill during this time?

Solution:

To find the average, add all the bills and divide by the number of bills.

$$\begin{array}{r} \$\ 47.16 \\ 59.25 \\ 63.75 \\ 43.50 \\ 59.25 \\ 87.16 \\ \hline \$360.07 \end{array}$$

$$\frac{\$360.07}{6} = \$60.01$$

A. Problems with Solutions (continued)

3. Find the cost of shipping 37 boxes whose average weight is 26.25 lbs at 16.5¢ per hundred pounds.

Solution:

Total weight = (26.25 lbs/box)(37 boxes)

= 971.25 lbs

971.25 lbs expressed in hundreds of lbs = 9.7125 hundred lbs

Cost = (9.7125 hundred lbs)($0.165/hundred lbs)

= $1.60

4. J. Jenkins worked 43 hours during the week at the rate of $2.35 an hour. What were his gross earnings if he was paid 1 1/2 times his regular rate for any time over 40 hours?

Solution:

For 40 hours work he makes

(40 hrs)($2.35/hr) = $94.00

For his overtime he makes

(43 hrs - 40 hrs)($2.35/hr)(1.5) = (3 hrs)($3.525/hr)

= $10.575 rounds to $10.58

Total Pay = $94.00 + $10.58 = $104.58

5. Mrs. Harvey assembles, on an average, 217 items per day at 12¢ each. How much does she earn in a week if she maintains this average for 6 days?

Solution:

In one day she earns

(217 items)($0.12/item) = $26.04

In 6 days she would earn

($26.04)(6) = $156.24

B. Problems without Solutions

6. From 26.653 tons of steel, 18.36 tons are sold. How many tons are left?

   Solution:

7. If 35.6 miles of highway cost $1,157,000, what would 46.3 miles cost at the same price per mile?

   Solution:

8. Upholstery fabric costs $3.97 a yard. What is the cost of 12.35 yards?

   Solution:

9. During the week, R. J. Hopland worked 8.25 hours, 7 hours, 10 hours, 7.75 hours, 6.75 hours and 4 hours. If he received $6.50 per hour, how much did he earn?

   Solution:

10. What is the tax on a piece of property if the assessed valuation is $660 and the tax rate is $8.33 per 100?

    Solution:

B. Problems without Solutions (continued)

11. Arrange the following discount factors in ascending order (from least to greatest):

.36 _____

.045 _____

.095 _____

.2625 _____

.1875 _____

Solution:

12. Pencils for the office cost two and forty-three hundredths cents a piece. How much would one gross (144) cost?

Solution:

13. A building contractor subdivided his land of 450 acres into 1.5-acre lots. How many 1.5-acre lots did he have?

Solution:

14. A small component part for a motor costs 3 3/8¢. How much would 1,000 of these cost?

Solution:

B. Problems without Solutions (continued)

15. A land developer purchased a piece of land containing 231.38 acres. He plans to divide it into lots of 0.46 acres each. How many lots will the piece of land make?

Solution:

16. Calculate the total cost of the following building materials:

7,115 ft siding	$12.80 per C	_____
4,870 ft flooring	$91.50 per M	_____
15,280 bricks	$101.00 per M	_____
14,900 sq ft shingles	$8.10 per C	_____
	TOTAL COST	_____

Solution:

17. Mrs. Hynes receives $370.00 a month for 4-40 hour weeks as an office clerk. She is paid time and a half for overtime. If she works 15 hours overtime during the month, how much are her total earnings? Compute hourly wage correct to 4 decimals.

Solution:

B. Problems without Solutions (continued)

18. A man worked 7 hours on Tuesday, 5.5 hours on Saturday, and 8 hours on other days except Sunday. At $2.125 an hour, what did he earn for the week? (Use time and a half for overtime.)

Solution:

19. The Falken Manufacturing Company pays its secretaries $570 a month and its typists $450 a month. What is the hourly rate in each case if the work week is 40 hours and the month is 4 weeks long?

Solution:

20. An apartment building is insured against fire for $325,000 which is divided between 3 companies. Insurance is carried by Company A for $120,000 at $0.76 per $100, by Company B for $175,000 at $0.61 per $100, and by Company C for the balance at $0.89 per $100. Find the annual premium paid by each company and the total premium.

Solution:

Complete Solutions to B Problems

6. The rule for subtracting decimals is the same as for adding - keep the decimals in a line.

$$\begin{array}{r} 26.653 \text{ tons} \\ -18.36 \text{ tons} \\ \hline 8.293 \text{ tons} \end{array}$$

7. $\frac{\$1,157,000}{35.6 \text{ miles}} = \$32,500 \text{ per mile}$

($32,500/mile)(46.3 miles) = $1,504,750

8. (12.35 yards)($3.97/yard) = $49.03

9. 8.25 hr + 7 hr + 10 hr + 7.75 hr + 6.75 hr + 4 hr = 43.75 hr

(43.75 hr)($6.50/hr) = $284.38

10. $(\$660)\left(\frac{\$8.33}{\$100}\right) = (\$660)(0.0833)$

= $54.98

11. A discount factor is a number we multiply the price by to see how much is to be taken off the price. To compare the decimals it is easy to see if we add zeroes after the decimals so: 0.3600, 0.0450, 0.0950, 0.2625, 0.1875.

In ascending order they would be:

0.045
0.095
0.1875
0.2625
0.3600

12. (144 pencils)(2.43¢/pencil) = (144 pencils)($0.0243/pencil)
= $3.50

13. $\frac{450 \text{ acres}}{1.5 \text{ acres/lots}} = 300 \text{ lots}$

14. ($0.03375/part)(1,000 parts) = $33.75

Complete Solutions to B Problems (continued)

15. $\frac{231.38 \text{ acres}}{0.46 \text{ acres/lot}} = 503 \text{ lots}$

16.

(71.15 hundred ft)($12.80/hundred ft)	= $ 910.72
(4.87 thousand ft)($91.50/thousand ft)	445.61
(15.28 thousand bricks)($101.00/thousand bricks)	1,543.28
(149 hundred sq ft)($8.10/hundred sq ft)	1.206.90
TOTAL COST	$4,106.51

17. $\frac{\$370}{160 \text{ hrs}} = \$2.3125/\text{hr}$

Total earnings = $370 + ($2.3125/hr)(15 hr)(1.5)
= $370 + $52.03
= $422.03

18. Total hours = 7 hrs + 5.5 hrs + 4(8 hrs)
= 44.5 hrs
Gross pay = (40 hrs)($2.125/hr) + (4.5 hrs)($2.125/hr)(1.5)
= $85.00 + $14.34
= $99.34

19. Secretaries: $\frac{\$570/\text{month}}{(40 \text{ hrs/week})(4 \text{ weeks/month})} = \$3.56$ per hour

Typists: $\frac{\$450/\text{month}}{(40 \text{ hrs/week})(4 \text{ weeks/month})} = \$2.81$ per hour

20. ($120,000) $\left(\frac{\$0.76}{\$100}\right)$ = $912.00 Company A

($175,000) $\left(\frac{\$0.61}{\$100}\right)$ = $1,067.50 Company B

$325,000 - ($120,000 + $175,000) = $30,000

($30,000) $\left(\frac{\$0.89}{\$100}\right)$ = $267.00

Total Premium = $912.00 + $1,067.50 + $267.00
= $2,246.50

A. Problems with Solutions

1. The valve stem clearance on a certain engine is 0.0015" - 0.001". If the stem measures 0.343", what would the maximum bore of the valve guide be?

   Solution:

   Maximum bore = 0.343" + 0.0015" = 0.3445 in

2. A standard shim pack is 0.0675". A shim check shows the bearing to have 0.007" clearance. If 0.002" is the correct clearance, what thickness of shims must be removed from each side of the bearing?

   Solution:

   0.007" - 0.002" = 0.005 inch of <u>each</u> shim pack must be removed

3. A damaged crankshaft measured 1.742" at the oil hole, 1.750" at right angles to the oil hole, 1.749" at one end of the journal and 1.744" at the opposite end of the journal. How many thousandths flat is the shaft and how much taper to the journal?

   Solution:

   Flatness of shaft = 1.750" - 1.742" = 0.008 in

   Taper of journal = 1.749" - 1.744" = 0.005 in

B. Problems without Solutions

4. The height of the end of the valve stem on a six cylinder engine is 1.3875" above the end of the guide after the valve has been seated and ground. If the specifications call for 1.375", what correction must be made?

B. Problems without Solutions (continued)

5. A cylinder measures 3.888 inches at the top (just below the ring ridge) and 3.877"at the bottom. What is the standard bore and what is the amount of wear and taper in the cylinder?

6. The cylinder of an engine was measured to be 3.332" just below the ring ridge. If the bore is in increments of 1/32" and it is known that the engine had not been rebored, what is the amount of taper in the cylinder?

7. A bearing journal measure 1.996". If the standard readings are in increments of 1/32" or greater, what is the probable standard size, and how much undersize is the shaft?

8. A rule of thumb for fitting crankshaft bearings is 0.001" per inch of diameter plus 0.0010" per foot of diameter (±0.0005"). An engine has a rod journal of 2.625". What should be the minimum and maximum bearing clearances?

B. Problems without Solutions (continued)

9. The distance from top to bottom of the piston travel is 4.5". If the main journal is 2.125" and the rod journal is 1.998", what is the distance between the surfaces of the two journals?

10. Some shops charge customers a straight hourly rate of $10.50 retail labor cost and pay their mechanics from $3.75-$5.50 hourly wages. If a certain job has a motor overhaul which takes 24.5 labor hours and a brake reline which takes 7.5 labor hours (total of 32 labor hours), what would the retail labor cost be? What would the shop pay the motor overhaul mechanic @ $5.50 per hour, the brake mechanic @ $3.75 per hour, and the mechanics helper who worked with both mechanics @ $2.25 per hour? What would be left for other shop expenses and profit?

B. Problems without Solutions (continued)

11. The following parts were used in an engine overhaul. The list price is given. What is the retail price of the parts?

Qty	Item	Unit List
8	spark plugs	$ 1.42
1	set gaskets	21.00
1	set rings	32.80
4	valves	4.25
8	wrist pins	1.62
16	valve springs	1.20
8	rod bearings	2.40
4	main bearings	4.20
1	main bearing	6.50

B. Problems without Solutions (continued)

12. The following parts were used on an engine overhaul. The list price is given and the discount percentage. Find the shop cost.

Qty	Item	Unit List	Percent Disc
8	spark plugs	$ 1.42	42%
1	set of gaskets	21.00	33
1	set of rings	32.80	40
4	valves	4.25	35
8	wrist pins	1.62	40
16	valve springs	1.20	40
8	rod bearings	2.40	40
4	main bearings	4.20	40
1	main bearing	6.50	40

B. Problems without Solutions (continued)

13. On a brake job the following parts and labor were listed:

Qty	Item	Unit Retail Cost	
1	set lining	@ $32.80	
4	cylinder kits	@ 2.15	
4	drums turned	18.00	(total, outside labor)
	fluid	0.50	

4.2 hrs labor @ $10.50

If the mechanic received $4.00 per hour and the discount on the lining was 60% and the discount on the other parts was 35%, what was the shop profit on this job?

14. If the specifications on a small manifold nut call for 10 1/2 ft. lbs, this is hard to measure with a ft lb torque wrench. It may be desirable to convert this to inch lbs for greater accuracy of torque. What would this inch lb torque reading be?

15. A major gasoline company leases a station to an operator for $0.014 per gallon pumped. If the station pumped 18,000 gallons of gasoline in July, what "rent" did the operator pay?

B. Problems without Solutions (continued)

16. If a gasoline station leased for $450.00 per month, what amount of fuel must be sold to make the cost of the lease equal to 1.5 cents ($0.015) per gallon?

17. A gasoline station leased for $525.00 per month. It sells on the average, 15,500 gallons of gasoline per month. How much per gallon of gasoline sold goes to pay the monthly lease?

18. On a certain engine the adjustment of the hydraulic valve lifter linkage is "tighten adjustment until no lash is evident then take 3/4 of a turn more (cylinder at firing position)". If the adjustment thread has a pitch of 1/32", how many thousandths will have to "bleed out" of the lifter before the valve will seat?

19. What is the average piston speed of an engine with a 3.875" stroke turning at 4,000 RPM? (RPM: revolutions per minute)

20. Given an engine with the following specifications: Main journal 2.873" diameter, stroke 4.125". At 3,000 RPM which is greater, the piston speed or the main bearing speed? By how much?

B. Problems without Solutions (continued)

21. An aluminum piston skirt is cammed to allow for expansion when heated. The head of the piston is relieved in all diameters. If aluminum expands 3/16" per foot at normal engine heat, what should be the minimum piston head relief in an engine with a 4" bore? (cammed piston: a piston which has an oval shaped skirt with the long axis of the oval at right angles with the wrist pin.)

22. The force on a clutch disc is 914 lbs. If the pressure plate has 12 springs, what must the force of each spring be?

23. The calculated coefficient of friction for rubber on concrete is 0.70. If a 3,700 lb car with brakes applied, skids all four tires, what is the force used to stop or decelerate the car?

24. A standard bearing shell measures 0.0825". If the shaft is turned to 0.010 undersize, what should the new shell measure in thickness?

25. An engine has a manifold vacuum reading of 18" of mercury. What is the manifold pressure available to charge the cylinder? (Use 30" as atmospheric pressure. PSI: pounds per square inch.)

B. Problems without Solutions (continued)

26. If an 8 cylinder engine turns at 3500 RPM, how many inpulses must the coil produce per minute? per second? (IPM: impulses per minute. IPS: impulses per second.)

27. When a bearing shell was installed in a connecting rod cap, it was observed to have 0.009" crush. If the standard crankshaft journal was 2.25" and the clearance was 0.002" ± 0.0005", what would be the ID of the installed bearing? What would be the ID of the bearing shells before tightening? (ID: inside diameter. Crush: protuberance of bearing shell above mating surface of "rod" cap.)

28. If there were 80,000 automobiles with 400 cubic inch engines, operating at 0.24 volumetric efficiency, turning 3400 RPM at 60 mph, driving over <u>one</u> mile of the freeway in a 24 hour period, what total amount of air would be used by the vehicles?

B. Problems without Solutions (continued)

29. Damage repair estimate on 1963 Pontiac-minor collision:

Parts	Cost	Labor (hrs)
hood panel	$ 97.60	0.7
hinge assy, R	9.83	0.5
lock bolt	2.14	0.2
lock assy	7.40	0.3
fender	82.17	2.4
Bonneville/name	18.25	1.5
grille	64.86	0.6
radiator core	124.60	1.3
paint	8.00	3.5
	$415.85	11.0

In some shops it is customary to add 10% for extra labor if the car is over 10 years old. If this is done, what is the total bid for repairing the car? Shop charge for labor is $11.00 per hour. (assy: assembly. R: right.)

Complete Solutions to B Problems

4. 1.3875" - 1.375" = 0.0125" to be ground from the end of the valve stem

5. Standard size would be (probably) the closest English unit of measure below 3.877" or 3.875" (3 7/8").

Wear = 3.877" - 3.875" = 0.002 in

Taper = 3.888" - 3.875" = 0.013 in

6. 3.332" lies between the increment possibilities of 3.3125" (3 5/16") and 3.34375" (3 11/32"). Wear on a cylinder increases the size, so the smaller measurement would seem reasonable. The bore standard is 3 5/16 inches.

Taper = 3.3320" - 3.3125" = 0.0195 in

7. 1/32" = 0.03125 in

2.00000" - 0.03125" = 1.96875 in

The shaft is larger than 1 31/32" but smaller than 2". The shaft standard must be 2" and the undersize is 0.004 in. (2.000" - 1.996" = 0.004 in)

8. A 2.625" journal would call for 0.0026" ± 0.0005" clearance.

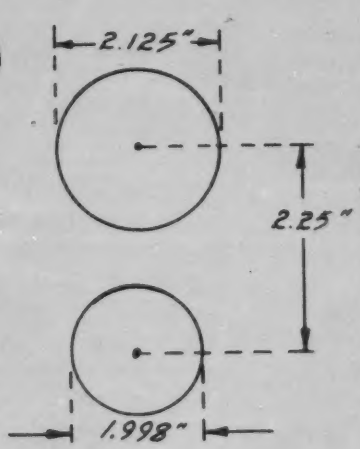
Maximum clearance = 0.0026" + 0.0005" = 0.0031 in

Minimum clearance = 0.0026"- 0.0005" = 0.0021 in

9. Distance between surfaces $= 2.25" - \left(\frac{2.125"}{2} + \frac{1.998"}{2}\right)$

$= 2.25" - 2.0615"$

$= 0.1885$ in



Complete Solutions to B Problems (continued)

10. Retail labor cost = (32 ~~hrs~~)($10.50/~~hr~~) = $336.00

Motor overhaul mechanic = (24.5 ~~hrs~~)($5.50/~~hr~~) = $134.75

Brake mechanic = (7.5 ~~hrs~~)($3.75/~~hr~~) = $28.13

Mechanic's helper = (32.0 ~~hrs~~)($2.25/~~hr~~) = $72.00

Total labor cost = $134.75 + $28.13 + $72.00 = $234.88

Left for shop expenses and profit = $336.00 - $234.88

= $101.12

11.

8	spk plgs	@ $ 1.42	=	$ 11.36
1	st gskts	@ 21.00	=	21.00
1	st rings	@ 32.80	=	32.80
4	valves	@ 4.25	=	17.00
8	wrst pins	@ 1.62	=	12.96
16	lvle sprgs	@ 1.20	=	19.20
8	rod brgs	@ 2.40	=	19.20
4	mn brgs	@ 4.20	=	16.80
1	mn brg	@ 6.50	=	6.50
				$156.82 total retail parts

12.

8	spk plugs....	(8)($1.42)(0.58)	= $ 6.59
1	st gskts.....	(1)($21.00)(0.67)	= 14.07
1	st rings.....	(1)($32.80)(0.60)	= 19.68
4	valves.....	(4)($4.25)(0.65)	= 11.05
8	wrst pins....	(8)($1.62)(0.60)	= 7.78
16	vlve sprgs...	(16)($1.20)(0.60)	= 11.52
8	rod brgs.....	(8)($2.40)(0.60)	= 11.52
4	mn brgs.....	(4)($4.20)(0.60)	= 10.08
1	mn brgs.....	(1)($6.50)(0.60)	= 3.90
		Total shop cost	$96.19

13. lining (1)($32.80)(0.60) = $19.68
cylinder kits (4)($2.15)(0.35) = $3.01
drum turn ($18.00)(0.35) = $6.30
fluid ($0.50)(0.35) = $0.18

Profit on parts = $19.68 + $3.01 + $6.30 + $0.18
= $29.17
Profit on labor = (4.2 ~~hrs~~)($10.50/~~hr~~ - $4.00/~~hr~~)
= (4.2 ~~hrs~~)($6.50/~~hr~~) = $27.30
Total shop profit = $27.30 + $29.17 = $56.47

Complete Solutions to B Problems (continued)

14. (10.5 ~~ft~~ lbs)(12 in/~~ft~~) = 126 inch lbs

15. Rent for July = ($0.014/~~gal~~)(18,000 ~~gal~~) = $252.00

16. Amount of fuel must be sold = $\frac{\$450.00}{\$0.015/\text{gal}}$ = 30,000 gal

17. Pays on monthly lease = $\frac{\$525.00}{15{,}500 \text{ gal}}$ = $0.0338/gal or $0.034/gal

18. One turn of the adjusting screw would move 1/32" (0.03125")

(3/4)(0.03125 in) = 0.0234 in

19. (2 ~~strokes~~/rev)(3.875 in/~~stroke~~) = 7.75 in/rev

(7.75 in/~~rev~~)(4,000 ~~rev~~/min) = 31,000 in/min at 4,000 RPM

20. In one complete turn the bearing will move 2.873" x 3.1416" or 9.026". The piston will move 2 x 4.125" or 8.25". In one turn the bearing will move (9.026" - 8.25") 0.776" farther than the piston. At 3,000 RPM (3,000 x 0.776") the speed of the bearing is 2,328 inches per minute greater than the piston speed.

21. Expansion of 4" diameter = (0.3333 ~~ft~~)(0.1875 in/~~ft~~) = 0.0625 in

This would be the minimum relief of the piston head. The actual relief would be much greater.

22. Force = $\frac{914 \text{ lbs}}{12 \text{ springs}}$ = 76.17 lbs/spring

23. x = stopping force

$\frac{x}{3{,}700 \text{ lbs}} = 0.70$

x = (0.70)(3,700 lbs)
x = 2,590 lbs

Complete Solutions to B Problems (continued)

24. New shell = 0.0825" + $\frac{0.10"}{2}$ = 0.0825" + 0.05 = 0.1325 in

25. Available in manifold to charge the cylinder:

$$\left(\frac{30" - 18"}{30"}\right)(14.7 \text{ PSI}) = \left(\frac{12 \text{ in}}{30 \text{ in}}\right)(14.7 \text{ PSI})$$

$$= 5.88 \text{ PSI}$$

26. $\left(\frac{3{,}500 \text{ rev/min}}{2 \text{ rev/impulses}}\right)(8) = 14{,}000$ impulses/min

$$\frac{14{,}000 \text{ impulses/min}}{60 \text{ sec/min}} = 233.33 \text{ impulses/sec}$$

27. ID of installed bearing = 2.25" + 0.004" = 2.254 in

The circumference of the installed bearing would be (2.254")(π) or 7.0812"; but before tightening, this circumference would be (7.0812" + 0.009") or 7.0902" and the ID of the bearing before tightening would be (7.0902 ÷ π) = 2.257 inch

28. Cubic feet of air used over a one mile length of the freeway:

$$\frac{(0.24)(400 \text{ cu in})(1{,}700 \text{ RPM})(80{,}000)(24 \text{ hrs})(60 \text{ min/hr})}{1{,}728 \text{ cu in/cu ft}}$$

= 10,880,000,000 cu ft

29.

hood panel	$ 7.70
hinge assy, R	5.50
lock bolt	2.20
lock assy	3.30
fender	26.40
Bonneville/name	16.50
grille	6.60
radiator core	14.30
paint	38.50
Total labor cost	$121.00

Total parts	$415.85
Total labor	121.00
10% of labor	12.10
Total repair bill	$548.95

A. Problems with Solutions

1. The following pieces of equipment with the given weight and arm are installed on a plane with empty weight of 1,282.5 pounds, and empty C G (Center of Gravity) of 37.4 inches. Find the new empty C G.

Item	Weight	Arm
Lear Comb D M	27.5 lb	72 in
Turn and Bank	2.0 lb	15 in
Rate of Climb	1.0 lb	15 in
Sen Alt Wt Inc	0.5 lb	15 in
Clock	0.5 lb	17 in
Sun Visors	1.5 lb	32 in

Solution:

All of the weights including that of the plane must be multiplied by the corresponding arm to find the moment for each. The sum of the moments divided by the sum of the weights will give the new C G.

Weights	Arm	Moments
1,282.5 lb	37.4 in	47,965.5 in-lbs
27.5 lb	72 in	1,980.0 in-lbs
2.0 lb	15 in	30.0 in-lbs
1.0 lb	15 in	15.0 in-lbs
0.5 lb	15 in	7.5 in-lbs
0.5 lb	17 in	8.5 in-lbs
1.5 lb	32 in	48.0 in-lbs
1,315.5 lb		50,054.5 in-lbs

$$\frac{50{,}054.5 \text{ in-lbs}}{1{,}315.5 \text{ lb}} = 38.05 \text{ in} \quad \text{new ECG}$$

B. Problems without Solutions

2. Find the expansion of a piece of aluminum 6 inches long if the temperature is raised 5 F. A coefficient of expansion of any metal is the amount that that metal will expand per inch for each degree rise in temperature (F°). For aluminum, this is 0.00001234.

3. If a seaplane weighs 2,000 lb, and the floats have a total volume of 64 cu ft, approximately how much of the floats must be submerged to support the seaplane? (1 cu ft = 62.4 lb)

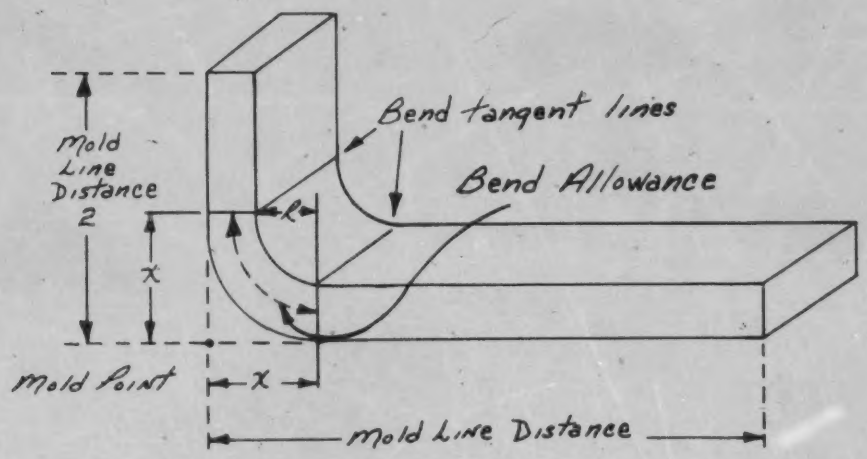
4. How much force can be applied by a pressure of 80 psi on a piston 8 inch in diameter? (Compute the area of the piston first.)

B. Problems without Solutions (continued)

Information for problems 5, 6, 7, 8, 9, and 10.

Bending is a forming operation used extensively in aircraft work. A curved corner requires less material than a square corner, and it must be possible to cut the stock correctly before the bending is to be done.

The BEND ALLOWANCE (BA) is that part required to make a bend over a given inside radius. It is the distance between bend tangent lines before the bend is made.



The amount of material saved by bending around a radius is called SETBACK. This needs to be known since the length (developed width) of material we shall see is equal to the sum of the mold line distances minus the setback.

To find the setback, both the BA and the "x" distance must be known. The x distance may be found by using a k chart (This is a table of values for the tangent function; k is the tangent of one half of the bend angle.). The formula for finding x distance = (K)(R + T) where R is the inside radius bend, and T is the thickness of the metal.

An empirical formula has been derived suitable for determining BA.

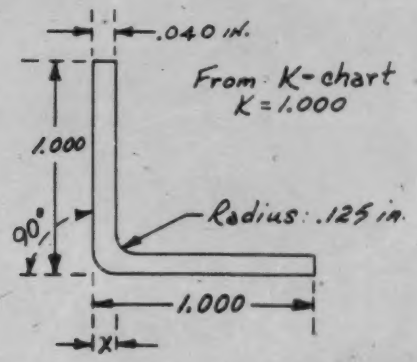
BA = (0.01743R + 0.0078T) (number of degrees in bend)

When x distance and BA are known, then, Setback = 2x - BA

The amount of material required to make the part is called the DEVELOPED WIDTH (DW). So, DW = MLD_t - SB_t, where MLD_t = total mold line distance and SB_t = sum of the setbacks

B. Problems without Solutions

The next five problems refer to this drawing:



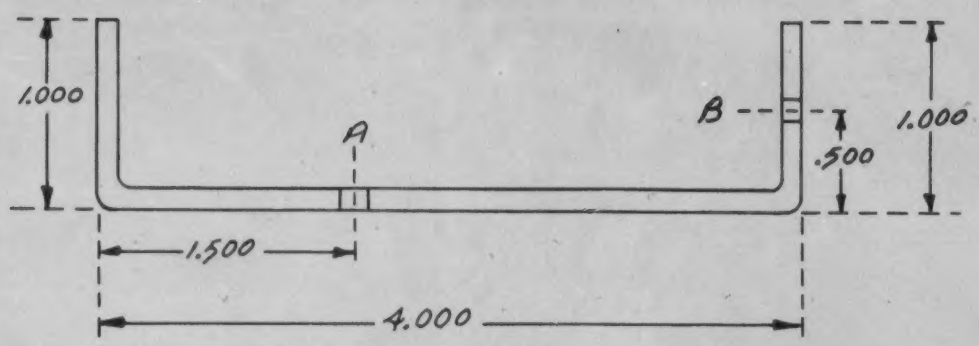
5. Refer to drawing. Find the x distance.

6. Refer to the drawing. Find the bend allowance.

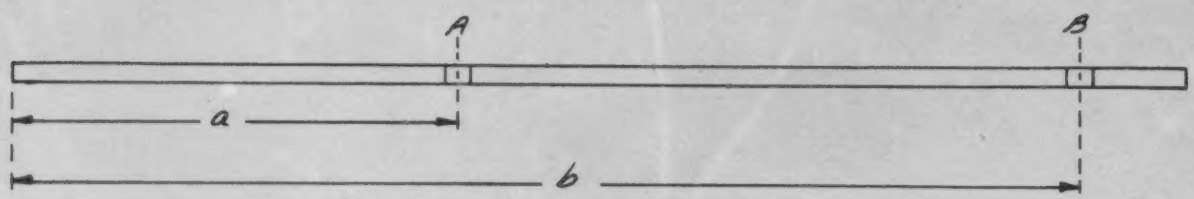
7. Refer to the drawing. Find the setback.

8. Refer to drawing. Find developed width.

9. Refer to drawing. On the flat layout, what would be the length of one unbent part or flange? (that part between the tangent line and end of piece)



10. The drawing above represents a finished product. Before bending, when the metal lay flat, find the dimensions a, and b, which would locate the centerlines for A, and B, if the setbacks for each bend is 0.106 in.



Complete Solutions to B Problems

2. (6 inches)(5)(0.00001234) = 0.0003702 inches

3. The seaplane will displace 2,000 lb of water. If the weight of 1 cu ft of water is 62.4 lb, then 2,000 lb ÷ 62.4 lb/cu ft $= \frac{2{,}000}{62.4} \approx$ 32 cu ft half submerged.

4. $A = \pi r^2 = (3.14)(4^2) = 50.27$ sq in

(80 psi)(50.27 sq in) = 4021.60 lb

5. $x = (K)(R + T) = (1.000)(0.125 \text{ in} + 0.040 \text{ in})$

$= 0.165$ in

6. $BA = \left[(0.0173)(0.125 \text{ in}) + (0.0078)(0.040 \text{ in})\right] (90)$

$= (0.00217875 \text{ in} + 0.0003120 \text{ in})(90)$

$= 0.22416750$ in

≈ 0.223 in

7. $SB = 2x - BA$ Since x and BA have been determined in the previous two problems, we have $SB = (2)(0.165) - 0.223$

$= 0.107$ in

8. $DW = MLD_t - SB_t = 1.000 \text{ in} + 1.000 \text{ in} - 0.107 \text{ in} = 1.894$ in

9. Since $x = 0.165$ in, then 1.000 in − 0.165 in = 0.835 in

10. When holes are to be drilled before bending their centerlines are to be treated as mold-line dimensions.

a = 1.000 in + 1.500 in − 0.106 in = 2.394 in

b = 1.000 in + 4,000 in + 0.500 in − 0.212 in = 5.288 in

A. Problems with Solutions

1. 1"x1"x1/8" steel bar will weigh 0.8 pounds per foot. What is the weight of a 20.5' bar?

   Solution:

   Multiply the weight per foot by the length of the bar.

   (0.8 lbs/foot)(20.5 feet) = 16.4 pounds
   The total weight of the bar is 16.4 pounds

2. A stock 20' bar of 7 inch I-beam weighs 306 pounds. What is the weight of a 16' bar?

   Solution:

   To find the weight of a 16' bar, we must first find the weight of a 1' bar.

   $$\text{Weight of 1 foot} = \frac{306 \text{ lbs}}{20 \text{ feet}} = 15.3 \text{ lbs per foot}$$

   Weight of 16 ft = (15.3 lbs/foot)(16 ft) = 244.8 lbs

   The weight of a 16 foot bar is 244.8 lbs

3. A stock 20 ft length of 3-inch channel weighs 82 lbs and costs $00.265 per pound. What is the cost of 116 inches of 3-inch channel?

   Solution:

   Need to find weight of the 116 inches of 3-inch channel.

   $$\text{Weight of 1 foot} = \frac{82 \text{ lbs}}{20 \text{ ft}} = 4.1 \text{ lbs/ft}$$

   Need to figure how many feet in 116 inches by dividing by the numbers of inches in one foot.

   $$\frac{116 \text{ in}}{12 \text{ in/ft}} = 9.67 \text{ feet or } 9 \text{ ft } 8 \text{ in}$$

   weight of 9.67 ft = (4.1 lbs/foot)(9.67 ft) = 39.647 lbs
   Cost = (39.647 lbs)($.265/lb)
   = $10.506
   Then the cost of 116 inches of 3 inch channel is $10.51.

B. Problems without Solutions

4. A 1/2 ton pickup has a load capacity of 4500 pounds. How many sheets of galvanized 60" x 144" 24 gauge steel could be carried if the estimated weight per sheet is 69.4 pounds?

   Solution:

5. A stock 8"x8" H-beam weighs 32.6 lbs per foot. Find the weight of a beam 87 1/4 inches in length.

   Solution:

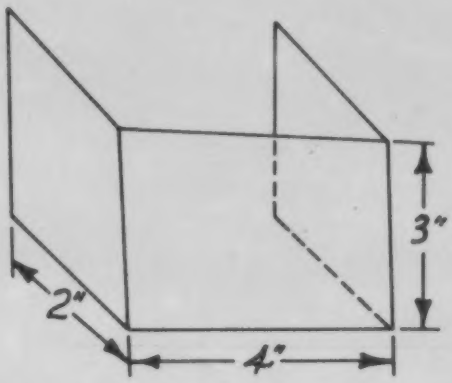
6. If a welder receives an hourly wage of $6.38 with time and one-half being paid for any hours over 40 during a given week, find his gross pay for a week in which he puts in 56 hours.

   Solution:

B. Problems without Solutions (continued)

7. Eight (8) pieces as pictured are to be constructed from 1/4"x3" F.B. whose weight is 2.55 lbs per ft and whose cost is $00.235 per pound. Find the cost of the steel.

Solution:



8. If you receive an hourly wage of $7.14 with time and one-half being paid for any hours over 40 during a given week, compute your gross pay for the week whose time card reads as follows: Mon, 9 hrs; Tue, 10 hrs; We, 8 hrs; Thu, 9 hrs; Fri, 10 hrs; Sat, 4 hrs.

Solution:

9. Find the cost of 1/8" electrodes if there is 12.5 feet to be welded with two stringer passes and if each electrode will weld 8". The cost of the electrodes is $00.76 per lb and there are 12.6 electrodes per lb.

Solution:

Complete Solutions to B Problems

4. Need to divide the load capacity of the pickup by the weight per sheet.

$\frac{4{,}500 \text{ lbs}}{69.4 \text{ lbs}} = 64.84$ Therefore, we can carry 64 sheets of galvanized 24 gauge steel

5. Need to find how many feet in 87 1/4 inches and then multiply by the weight per foot.

$\frac{87\ 1/4 \text{ in}}{12 \text{ in/ft}} = 7.27 \text{ ft}$

(7.27 ft)(32.6 lbs/ft) = 237 lbs So the beam weighs 237 lbs.

6. Need to compute his (or her) total wage for 40 hours and add to wages for hours over 40.

(40 hrs)($6.38/hr) = $255.20 regular pay
($6.38)(1.5) = $9.57 overtime rate
56 hours - 40 hours = 16 hours overtime
($9.57/hr)(16 hrs) = $153.12 overtime pay
$153.12 + $255.20 = $408.32

So the total pay is $408.32 for that week.

7. Need to find the total length of the pieces in feet and then find the total weight. To find the cost, we then multiply the total weight by the cost per pound.

8(2" + 4" + 2") = 64" total length in inches

$\frac{64 \text{ in}}{12 \text{ in/ft}} = 5.33'$ total length in feet

(5.33 ft)(2.55 lbs/ft) = 13.6 lbs total weight
(13.6 lbs)($0.235/lb) = $3.169
Then the cost of 8 pieces is $3.20

8. Need to find amount of regular and overtime hours that have been worked. Then figure the regular pay and overtime pay and add them together.

9 hr + 10 hr + 8 hr + 9 hr + 10 hr + 4 hr = 50 hr
50 hr - 40 hr = 10 hr overtime
(40 hr)($7.14/hr) = $285.60 regular pay
($7.14/hr)(1.5) = $10.71/hr overtime rate
(10 hr)($10.71/hr) = $107.10 overtime pay
$107.10 + $285.60 = $392.70
So the total pay is $392.70

Complete Solutions to B Problems (continued)

9. Need to find how many 1/8" electrodes it will take to complete the job. Now find how many pounds of electrodes there are and multiply by the cost per pound.

Each electrode will weld 8" or .67ft. To find number of electrodes, we divide

$$\frac{12.5 \text{ feet}}{0.67 \text{ feet/electrode}} = 18.66 \text{ or } 19 \text{ electrodes}$$

Now divide by the number of electrodes in one pound.

$$\frac{19 \text{ electrodes}}{12.6 \text{ electrodes/lb}} = 1.51 \text{ lbs}$$

Now multiply by the cost per pound.

(1.51 lbs)($0.76/lb) = $1.148 So the cost will be $1.15

A. Problems with Solutions

1. One part in choosing a correct alternator for an ignition system is to find the daily ampere-hour load. This is determined by multiplying the current draw of each electrical component by the number of hours it is used each day. For instance, if panel lights draw 2 amps and they are operated for 5 hours, the ampere-hour load is 10. For each of the following components in a vehicle, compute the ampere-hour load, and find the totals.

Vehicle Loads	Amperes	Hours	Ampere-Hour Load
Ignition	4.0	10.0	
Wipers	7.5	10.0	
Heater	6.0	10.0'	
Radio	2.0	10.0	
Headlights (2)	7.5	5.0	
Panel lights	2.0	5.0	
Tail lights	1.0	5.0	
Stop lights	3.0	0.5	
Turn signal	3.0	0.5	
Starter	166.0	0.003	_____

Total Ampere-Hours (nearest tenth)

Extra Loads			
Phone receiver	5.0	10.0	
Phone transmitter	15.0	1.0	_____

Total Extra Ampere-Hours

TOTAL _____

Solution:

Multiply each amp figure by each hour figure to obtain:

Ignition	40.0 amp-hr	Turn signal	1.5 amp-hr
Wipers	75.0 " "	Starter	0.5 " "
Heater	60.0 " "		
Radio	20.0 " "	Total	251.0 amp-hr
Headlights	37.5 " "		
Panel lights	10.0 " "	Phone rec	50.0 " "
Tail lights	5.0 " "	Phone trans	15.0 " "
Stop lights	1.5 " "		
		Total Extra	65.0 amp-hr
		TOTAL	316.0 amp-hr

A. Problems with Solutions (continued)

2. If the diameter of a tractor wheel and tire is 44 inches, what is the circumference? How many revolutions would the wheel turn per mile if there are 5,280 feet per mile? (Use $C = \pi d$ where $\pi = 3.1416$ and d = diameter.)

Solution:

$C = (3.1416)(44") = 138.23$ in, $\quad 138.23 \text{ in} \approx 11.52$ ft

So, $\dfrac{5{,}280 \text{ ft/mile}}{11.52 \text{ ft/rev}}$ $\quad 458.3$ revolutions/mile

3. A 55 gallon drum of cleaning solvent in the shop is being used at the rate of 5 1/2 gallons per day. How many days will the drum last?

Solution:

$\dfrac{55 \text{ gal}}{5.5 \text{ gal/day}} = 10$ days

4. If the inside diameter of the main bearing bore is 4.750", the outside diameter of the main bearing journal is 4.499", and the thickness of the bearing shells is 0.1229", (a) what would the oil or journal-to-bearing clearance be?, and (b) how much difference is there between this measurement and the maximum worn replacement limit of 0.007 inches?

Solution:

(a) $4.750" - 4.499" - 2(0.1229") = 0.0052$ in

(b) $0.007" - 0.0052" = 0.0018$ in

B. Problems without Solutions

5. Compute the total ampere-hour load of the following, and find the minimum ampere-hour alternator suitable for this system remembering that the load should be 80% of what the alternator is capable of producing.

B. Problems without Solutions (continued)

5. (continued)

Electrical Unit	Amperes	Hours	Ampere-Hour Load
Clearance and Marker Lamps	0.5	4	
Coil	4.5	10	
Directional Signal Lamps	2.1	1	
Dome Lamps	1.0	4	
Gas Gauge	0.2	10	
Head Lamps - Upper	4.2	4	
- Lower	3.4	4	
Horn	7.0	0.1	
Instrument Lamp	0.3	4	
License Lamp	0.5	4	
Parking Lamps	0.6	1	
Spot Lamp	2.6	1	
Tail Lamp	0.6	4	
Stop Lamp	2.1	1	_____
		Total	_____

B. Problems without Solutions (continued)

6. In running a dynamometer test, the air temperature is reported as 30 degrees Centigrade. In order to adjust the dynamometer readings for temperature at the rate of 1 percent for each 10 degrees of Fahrenheit temperature rise above 60 degrees F., you must convert 30 degrees C. to Fahrenheit. What would the Fahrenheit reading be? ($F^{\circ} = 1.8\ C^{\circ} + 32^{\circ}$)

The next three problems require the following chart.

ENGINE MODEL DESIGNATION	HP @ RPM 500 Feet 85 F.	PT PUMP CODE	MAXIMUM FUEL Lb/Hr	MAXIMUM FUEL PSI	INTAKE PRESSURE In./Hg.	PEAK TORQUE	AT or BELOW RPM
J6(J-401)	95@1800	0537	40-43	40-50		313-329	1550
JN6(J-401)	124@2500	1716	48-52	55-65		315-331	1700
JNF6(J-401)	125@2800	0953	54-56	140-160		272-284	1500
JNR6(J-401)	96@1800	1257	39-41	75-95		313-329	1550
JF6(J-401)	105@2200	1722	46-48	47-63		295-309	1550
JS6(J-401)	150@2500	1615	70-75	135-155	11 Min	364-382	1825
JNS6(J-401)	165@2500	0710	73-76	140-160	11 Min	397-417	1950
JT6(J-401)	175@2500	0396	68-72	140-160	28-34(T-350)	399-419	1850
C-160(C-464)	152@2500	1560	64-68	100-120		369-387	1600
CF-160(C-464)	152@2500	1455	66-68	106-114	339-355	1900	
CR-160(CS-464)	160@2200	0732	64-66	120-140	7 Min	411-431	1700
C-175(CT-464)	175@2500	0952	69-72	155-175	26-32(T-350)	395-415	1900

7. If the C-160(C-464) engine in a test consumes 1.2 lbs of fuel in one minute, is this within the maximum fuel specifications?

B. Problems without Solutions (continued)

8. For the JF6(J-401) engine, what would be acceptable per minute consumption which would fall within the 46 - 48 pounds per hour specification?

9. From the chart, the JNS6(J-401) engine at 2500 rpm should develop what horsepower? (Chart on previous page.)

10. Suppose you were assigned to make a service call that required you to be away from the shop for 3 days. You are allowed $0.10 per mile and $20.00 a day for meals and lodging. When you begin your service call, you record your speedometer reading which is 40,346.8. When you return, the reading is 41,148.3. What would your total expense allowance be for this service call?

B. Problems without Solutions (continued)

11. The length of a new plunger in a pump is 2.6577 inches. It has been determined that the pump should be discarded if the plunger wear exceeds 0.005 inches. In checking a pump, it was found the plunger measured 2.6570 inches. Should it be discarded?

12. If the reading on a micrometer depth gauge is 3.650 inches plus or minus 0.001 inches, what are the maximum and minimum values the measurement can have?

13. If another reading was 3.710 inches $\pm$ 0.002 inches, what are the maximum and minimum values the measurement could have?

14. A manual specifies that the timing dimension should be between 1.992 inches and 2.012 inches. This can be measured with a depth micrometer and gauge. If the gauge is 2.000 inches long, what are the lower and upper limits of the micrometer reading?

B. Problems without Solutions (continued)

15. New cylinder liners in a certain series engine have an inside diameter of 5.1245 inches to 5.1260 inches. Reboring is necessary if wear has increased the inside diameter of the liner to 5.130 inches. If the maximum inside micrometer reading of the liner that you check is 5.138 inches, how far has this liner worn beyond maximum acceptable limits?

16. What is the micrometer reading midway between 0.015 inches and 0.025 inches?

17. What is the micrometer reading midway between 0.012 inches and 0.028 inches?

Complete Solutions to B Problems

5. Simply multiply each amp reading times the number of hours and obtain:

Clear and Mark	2	amp-hrs
Coil	45	" "
Direct Lamps	2.1	" "
Dome	4	" "
Gas	2	" "
Hd Lmp - U	16.8	" "
- L	13.6	" "
Horn	0.7	" "
Instrument	1.2	" "
License	2	" "
Parking	0.6	" "
Spot	2.6	" "
Tail	2.4	" "
Stop	2.1	" "
Total	97.1	ampere-hours

Also, letting x = the number of ampere-hours the alternator must have, and since the load of 97.1 ampere-hours represents 80% of x, we have:

$$0.80x = 97.1 \text{ amp-hrs}$$

$$x = \frac{97.1 \text{ amp-hrs}}{0.80}$$

$$x = 121.375 \text{ amp-hrs}$$

Therefore, we should not select an alternator with less than a 122 ampere-hour rating.

6. $F^{\circ} = 1.8\ C^{\circ} + 32^{\circ}$

$= 1.8(30^{\circ}) + 32^{\circ}$

$= 86^{\circ}$ degrees

7. According to the table, the range is 64 - 68 lbs per hour. At 1.2 per minute this would be

(1.2 lbs/min)(60 min/hr) = 72 lbs/hr which is over

Complete Solutions to B Problems (continued)

8. $\frac{46 \text{ lb/hr}}{60 \text{ min/hr}} = 0.77 \text{ lb/min}$

$\frac{48 \text{ lb/hr}}{60 \text{ min/hr}} = 0.80 \text{ lb/min}$

9. From the second column on the chart, the answer is 165 hp

10. 41,148.3 miles - 40,346.8 miles = 801.5 miles

So, (801.5 miles)($0.10/mile) = $80.15
(3 days)($20/day) = $60.00

Total $140.15

11. 2.6577" - 0.005" = 2.6527 inches

No, it should not be discarded; 2.6570" is well above the minimum value of 2.6527 inches.

12. 3.650" + 0.001" = 3.651 inches

3.650" - 0.001" = 3.649 inches

13. 3.710" + 0.002" = 3.712 inches

3.710"- 0.002" = 3.708 inches

14. 1.992" + 2.000" = 3.992 inches

2.012" + 2.000" = 4.012 inches

15. 5.138" - 5.130" = 0.008 inches over worn

16. $\frac{0.015" + 0.025"}{2} = \frac{0.040"}{2} = 0.020$ inches

17. $\frac{0.012" + 0.028"}{2} = \frac{0.040"}{2} = 0.020$ inches

A. Problems with Complete Solutions

1. How many cuts would be needed to turn down 1.460" stock to 1" on a lathe, each cut being 0.023" deep?

   Solution:

   Find difference between stock and finished product, then divide by depth of each cut

   1.460" - 1.000" = 0.460 in

   $$\frac{0.460\ \cancel{in}}{0.023\ \cancel{in}/cut} = 20\ cuts$$

2. A machine shop makes a drill press which requires a round leather belt 3/16" diameter. The belting costs $0.08 per foot. Each drill press uses 38'. If 76 drill presses are made, what will be the belting cost?

   Solution:

   Need product of number of drill presses and length of belt per press and cost per foot of belt.

   Total cost = (76 ~~drill presses~~)(38 ~~ft~~/~~press~~)($0.08/~~ft~~)

   = $231.04

3. A draftsman is to draw 13 national course screw threads per inch on a piece of material 4" long. To the nearest 1/64", what is the distance between any two threads?

   (Note: a table of decimal equivalents of parts of an inch is included in the problems)

   Solution:

   13 threads per inch means 1/13" between threads

   1/13" ≈ 0.0769" ≈ 5/64 in

B. Problems without Complete Solutions

4. A broach has 40 teeth. Each tooth cuts 0.015". How much material does the entire broach remove?

Solution:

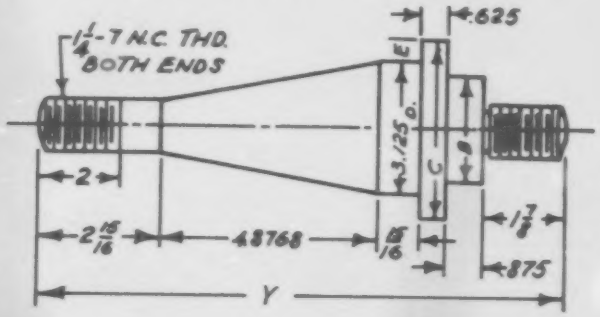
5. A drill makes 280 rpm and drills a hole 2.125" deep in 0.800 minutes. What is the feed?

(Feed is the distance the drill advances with each revolution)

Solution:

6. In the following figure, find the following information:

a) Find total length of Y.
b) If E = 0.250", what is the diameter of C to the nearest 1/8"?
c) If B = 2.0625" and C = 3.625", how much is taken off C on the lathe to make C = B? Find the answer to the nearest 1/16".
d) If the "rough side" of C = 3.625", how much of a "finished cut" would have to be taken from C to make it 3 9/16"?
e) E = 0.250". If the difference between diameter 3.125" and B is 4 times E, what is the value of B?



Solution:

B. Problems without Complete Solutions (continued)

7. If 17 holes are each 1.125" apart from ℄ to ℄, what is the distance from the center of the first hole to the center of the last hole?

   Solution:

8. The machine shop orders 18 second cut 10" hand files. Each one costs $0.69. What is the total cost?

   Solution:

9. A laminated shim is made up of 30 pieces of material. Each lamination is 0.002" thick. What is the thickness of the shim?

   Solution:

10. The metal fitting shop uses 9 oz of parting compound per day. If this compound costs $0.0425 per lb, how much will the shop spend in a year on parting compound? (16 oz = 1 lb, 365 days = 1 yr)

    Solution:

Decimal Equivalents of Parts of an Inch

1/64----.015625	17/64----.265625	33/64----.515625	49/64----.765625
1/32----.03125	9/32----.28125	17/32----.53125	25/32----.78125
3/64----.046875	19/64----.296875	35/64----.546875	51/64----.796875
1/16----.0625	5/16----.3125	9/16----.5625	13/16----.8125
5/64----.078125	21/64----.328125	37/64----.578125	53/64----.828125
3/32----.09375	11/32----.34375	19/32----.59375	27/32----.84375
7/64----.109375	23/64----.359375	39/64----.609375	55/64----.859375
1/8-----.125	3/8-----.375	5/8-----.625	7/8-----.875
9/64----.140625	25/64----.390625	41/64----.640625	57/64----.890625
5/32----.15625	13/32----.40625	21/32----.65625	29/32----.90625
11/64----.171875	27/64----.421875	43/64----.671875	59/64----.921875
3/16----.1875	7/16----.4375	11/16----.6875	15/16----.9375
13/64----.203125	29/64----.453125	45/64----.703125	61/64----.953125
7/32----.21875	15/32----.46875	23/32----.71875	31/32----.96875
15/64----.234375	31/64----.484375	47/64----.734375	63/64----.984375
1/4-----.25	1/2-----.5	3/4-----.75	1-----1.

Complete Solutions to B problems

4. Find product of number of teeth and amount each tooth cuts

Total cut = (40 teeth)(0.015 in/tooth)

= 0.6 in

5. To find the number of rev, multiply total rpm by length of time drill is in operation. Then divide total depth by number of revolutions.

Number of revolutions = (280 rpm)(0.800 min) = 224 rev

Cut per revolution = $\frac{2.125"}{224 \text{ rev}}$ = 0.0095 in per rev

6. a) Find sum of individual parts

Y = total length = 2 15/16" + 4.8768" + 15/16" + 0.625" +

0.875" + 1 7/8"

Y = 2.9375" + 4.8768" + 0.9375" + 0.625" + 0.875" + 1.875"

Y = 12.1268 in

b) Need sum of smaller diameter plus twice E

Large diameter = 3.125" + 2(0.250")

= 3.625" = 3 5/8 in

c) Need to find difference between C and B

Difference = C - B = 3.625" - 2.0625"

= 1.5625" = 1 9/16 in

d) Find difference between rough cut and finish cut. Need to change 9/16 to 3 decimal places.

Finish cut = 3.625" - 3 9/16"

= 3.625" - 3.5625"

= 0.0625 in

e) D - B = 4E

3.125" - B = 4(0.250")

3.125" - B = 1"

B = 2.125" = 2.125 in

Complete Solutions to B problems (continued)

7. There will be one less space between ℄ than the number of holes. We need the product of distance between ℄ and number of spaces.

$$\text{Total distance} = (16 \text{ spaces})(1.125 \text{ in/space})$$

$$= 18 \text{ in}$$

8. Find product of number of files and cost per file.

$$\text{Total cost} = (18 \text{ files})(\$0.69/\text{file})$$

$$= \$12.42$$

9. Find product of number of shims and the thickness per shim.

$$\text{Total thickness} = (30 \text{ shims})(0.002 \text{ in/shim})$$

$$= 0.06 \text{ in}$$

10. Need product of oz of compound per day, number of days in a year, change this to lbs by dividing by 16 and multiply by price per lb.

$$\text{Total cost} = \frac{(9 \text{ oz/day})(365 \text{ day/yr})(\$0.0425/\text{lb})}{16 \text{ oz/lb}}$$

$$= \$8.73 \text{ per year}$$

A. Problems with Solutions

1. How much will a concrete beam weigh if it is 6" side, 14" high, and 20' long. Concrete weighs 150 lb/cu ft.

Solution:

$V = (L)(W)(H)$

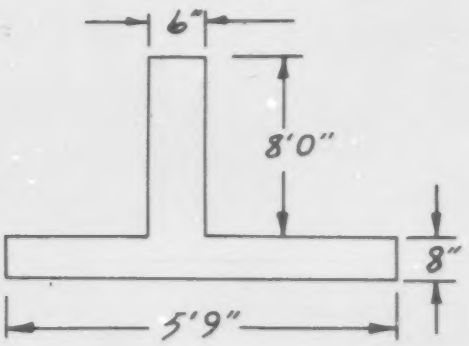
$= (240")(6")(14")$
$= 20{,}160$ cu in

(20,160 ~~cu in~~)(1 cu ft/1728 ~~cu in~~) = 11.67 cu ft

(11.67 ~~cu ft~~)(150 lb/~~cu ft~~) = 1,750 lb

B. Problems without Solutions

2. What will be the weight of a reinforced concrete retaining wall per foot if it has thefollowingdimensions?



B. Problems without Solutions (continued)

3. What will be the total dead load onto the foundation of a 29 ft length of granite mortared rubble masonry retaining wall with a cross section as given? (Weight = 115.5 lbs/cu ft)

4. How much of a dead load will a 3.5 ft fill of gravel weighing 125 lb/cu ft placed on a 15 ft wide by 20 ft long box culvert create? What is the load per square foot?

5. What will be the effective weight of a 60" x 10' x 20' concrete slab submerged in water? (Weight = 150 lbs/cu ft, weight of 1 cu ft water = 62.43 lb) Effective weight = (Weight of concrete) - (Volume weight of water displaced)

Complete Solutions to B Problems

2. Find the cross-sectional area of the wall in sq ft, and multiply it by 1 foot to find the volume of one foot of wall.

(96")(6") = 576 sq in
(69")(8") = 552 sq in
Total =1128 sq in

(1128 ~~sq in~~)(1 sq ft/144 ~~sq in~~) = 7.83 sq ft

(7.83 sq ft)(1 ft) = 7.83 cu ft

(7.83 ~~cu ft~~)(150 lbs/~~cu ft~~) = 1,175 lbs

3. Divide the picture into a square and a triangle and find the areas of each section, then, the cubic volume of 29-foot sections of each, and then add the two for the total volume

(6')(1') = 6 sq ft)
(6')(4')(0.5) = 12 sq ft

(6 sq ft)(29 ft) = 174 cu ft
(12sq ft)(29 ft) = 348 cu ft
Total Volume = 522 cu ft (522 ~~cu ft~~)(115.5 lbs/~~cu ft~~) = 60,291 lbs

4. V = (W)(L)(H)
= (15')(20')(3.5') = 1,050 cu ft

(1050 ~~cu ft~~)(125 lb/~~cu ft~~) = 131,250 lb

$$\frac{\text{load}}{\text{sq ft}} = \left(\frac{\text{volume}}{\text{sq ft}}\right)\left(\frac{\text{weight}}{\text{unit volume}}\right)$$

= (1')(1')(3.5')(125 lb/cu ft)
= (3.5 ~~cu ft~~)(125 lb/~~cu ft~~)
= 437.5 lb

5. (0.5')(10')(20') = 100 cu ft
(100 ~~cu ft~~)(150 lbs/~~cu ft~~) = 15,000 lbs

100 cu ft water weighs
(100)(62.43 lb) = 6,243 lb

Eff weight = 15,000 lb - 6,243 lb

= 8,757 lb

A. Problems with Solutions

1. A piece of pipe 3.4' long is shortened by 0.7'. How long are the two remaining pieces if the width of the saw cut is 0.125"?

   Solution:

   $3.4' = 40.8"$ $\qquad 0.7' = 8.4"$
   $40.8" - 8.4" - 0.125" = 32.275"$

   The two pieces are 0.7 ft and 32.275 in

2. A 5/16" bolt weighs 0.43 lbs. How many bolts are there in a 125 lb keg?

   Solution:

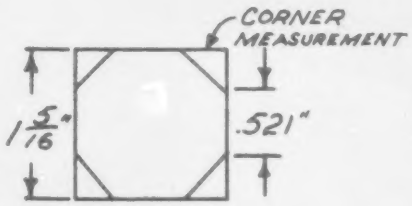
   $$\frac{125 \text{ lbs}}{0.43 \text{ lbs/bolt}} = \frac{(125 \cancel{\text{ lbs}} \times \text{bolt})}{0.43 \cancel{\text{ lbs}}} = 291 \text{ bolts}$$

3. What would be the corner measurement for laying out an octagonal end on a square bar as shown in the diagram below.

   Solution:

   $$\frac{1\ 5/16" - 0.521"}{2} = \frac{1.3125" - 0.521"}{2}$$

   $$= \frac{0.7915"}{2} = 0.396 \text{ in}$$



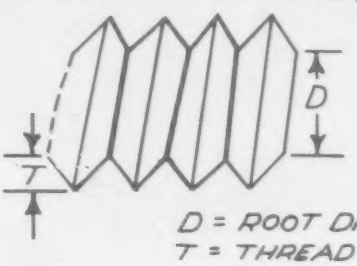
B. Problems without Solutions

4. A piece of steel weighs 162.3 lbs. A piece of aluminum weighs 0.51 as much as the steel. How much does the aluminum weigh?

B. Problems without Solutions (continued)

5. If a millwright earns $5.73 an hour and time and a half for overtime based on a 40 hour week, how much will he make in a 55 hour week?

6. A bolt is made from a piece of 3/4" stock. The thread depth is 0.041". What is the root diameter of the bolt? See the drawing.



D = ROOT DIA.
T = THREAD DEPTH

7. The actual inside diameter of a pipe is 1.12". The actual outside diameter is 1.316". Find the thickness of the pipe.

8. A shaft should be 1.317" in diameter. However, it is 1 3/16" in diameter. How much has it been worn?

B. Problems without Solutions (continued)

9. Fifteen equally spaced holes are to be drilled in a piece of metal 27 1/8" long. Allowing 1" on each end, how far will it be, to the nearest thousandth of an inch, from center to center of two consecutive holes?

10. Rule of Thumb:

The rim or cutting speed of a cylindrical rod is found by multiplying the circumference by the revolutions per minute. Find the cutting speed of a rod whose circumference is 2.42" turning at 120 rpms.

11. Rule of Thumb:

We can find the length of pipe needed to complete a bend by multiplying three numbers together: The radius of the bend, the degrees in the bend, and the constant 0.01745. To the nearest thousandth, find the length of pipe needed to complete a 22 1/2° bend with a radius of 13".

Complete Solutions to B Problems

4. $0.51(162.3 \text{ lbs}) = \text{about } 82.77 \text{ lbs}$

5. $40(\$5.73) + 15(1.5)(\$5.73) = \$229.20 + \$128.93$

$= \$358.13$

6. $d = 3/4" - 2(0.041")$

$= 0.750" - 0.082"$

$= 0.668 \text{ in}$

7. $\text{Thickness} = \frac{1.316" - 1.12"}{2} = 0.098 \text{ in}$

8. $\text{Amount worn} = 1.317" - 1\ 3/16" = 1.317" - 1.1875"$

$= 0.1295" \text{ or about } 0.130 \text{ in}$

9. $\frac{27\ 1/8" - 2(1")}{14} = \frac{25\ 1/8"}{14} = \frac{25.125"}{14} = 1.795 \text{ in}$

10. $\text{Cutting speed} = (2.42 \text{ in/rev})(120 \text{ rpms}) = 290.4 \text{ in/min}$

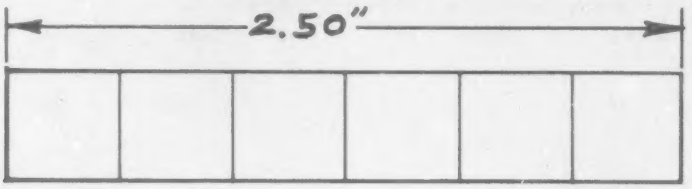
11. $\text{Length of pipe needed} = (13")(22\ 1/2^{\circ})(0.01745)$

$= (13")(22.5^{\circ})(0.01745)$

$= 5.104 \text{ in}$

A. Problems with Solutions

1. A steel sheet 2.5 inches wide is to be sheared into 6 strips of equal width. How wide will each strip be?



Solution:

$$\frac{2.5 \text{ inches}}{6 \text{ strips}} = 0.4167 \text{ inches/strip}$$

B. Problems without Solutions

2. How high would a pile of 18 metal sheets reach if each sheet is 0.0181 inches thick?

3. If nails cost $19.85 per 100-lb keg, how much would 539 pounds cost? (The 39 pounds were bought at the same rate.)

B. Problems without Solutions (continued)

4. How many metal sheets will there be in a stack of sheets approximately 24 inches high if each sheet is 0.0096 inches thick?

5. Concrete for a slab floor cost $341.42 at $19.85 per cubic yard. How many yards of concrete were used?

6. A blueprint gives a dimension of 4.140 inches + or - 0.005 inches. What would be the tolerance allowed in the manufacturing of the object?

7. A blueprint gives a dimension of 3.875 inches $\pm$ 0.03125 inches. What would be the tolerance allowed in the manufacturing of the object?

Complete Solutions to B Problems

2. $(0.0181 \text{ in/sheet})(18 \text{ sheets}) = 0.3258 \text{ inches}$

3. $\left(\frac{539 \text{ lbs.}}{100 \text{ lbs/keg}}\right)(\$19.85/\text{keg}) = \$106.9915 = \$106.99$

4. $\frac{24 \text{ inches}}{0.0096 \text{ in/sheet}} = 2{,}500 \text{ sheets}$

5. $\frac{\$341.42}{\$19.85/\text{cu yd}} = 17.20 \text{ cu yds}$

6. $4.140" + 0.005" = 4.145 \text{ inches}$

   $4.140" - 0.005" = 4.135 \text{ inches}$

7. $3.875" + 0.03125" = 3.90625 \text{ inches}$

   $3.875" - 0.03125" = 3.84375 \text{ inches}$

A. Problems with solutions

1. Calculated electrical loads for a house are:

Air conditioning	10.1	Kilowatts
1500 sq. ft. at 3 watts	4.5	"
Two 20 amp. small appliance circuits at 1500 watts	3.0	"
Laundry circuit	1.5	"
2 - ovens	8.0	"
1 - cooking unit	5.1	"
Water heater	4.5	"
Dishwasher	1.2	"
Washer/dryer	4.2	"

What is the total electrical load? _____

Solution:

10.1	Kw (kilowatts)
4.5	Kw
3.0	Kw
1.5	Kw
8.0	Kw
5.1	Kw
4.5	Kw
1.2	Kw
4.2	Kw
Tot. 42.1	Kw

B. Problems without solutions

2. From the table of AWG wire sixes below:

Gauge No.	Wire Diameter in inches
10	.1019
11	.0907
12	.0808
13	.0720
14	.0641
15	.0571
16	.0508
17	.0453
18	.0403

a) Find the difference in diameters between AWG No. 12 and AWG No. 16 _____

b) Which wire is larger in diameter? _____

B. Problems without solutions

3. A mapper lists the following items to be priced out for an estimate. You are to find the total cost per item and the grand total.

Account	Item Description	Quantity	Unit cost	Total Item Cost
364	40'pole	4	$117.65	$
365	CR	4	53.15	
	4 BHD	4530ft	0.12784	
	4 ACSR	1080ft	o.13597	
	2ACSR	1241ft	0.13076	
	1/0 ACSR	6870ft	0.14119	
	2Tx	160Ft	0.16999	
	c/o	9	37.00	
			Grand Total	$

Complete solutions to B problems

2;

a) AWG #12, .0808in
#16, -.0508in
.0300in; ans.

b) #12 wire is larger in diameter; ans.

3.

(4)	($117.65)	= $470.60
(4)	($ 53.15)	= $212.60
(4530)	($.12784)	= $579.12
(1080)	($.13597)	= $146.85
(1241)	($.13076)	= $162.27
(6870)	($.14119)	= $969.98
(160)	($.16999)	= $ 27.20
(9)	($ 37.00)	= $333.00
Grand Total		= $2901.62

A. Problems with solutions.

1. The speed of radio wave propagation in air and space is 186,280 miles per second. During an Apollo flight, it was noted that the radar echo from the spacecraft transponder required 2.216 seconds from the instant the pulse left the earthbound antenna. Neglecting time delays in the ground equipment, how far was the spacecraft from earth. (Distance = time x speed.)

Solution:

Divide time by two to get one-way time:

$$t = \frac{2.216 \text{ sec}}{2} = 1.108 \text{ sec.}$$

Distance of spacecraft from earth:

$$d = (1.108 \text{ sec}) \left(186{,}280 \frac{\text{miles}}{\text{sec}}\right) = 206{,}398.2 \text{ miles from earth}$$

B. Problems without solutions.

2. The bench technician has completed repairs on a 23 inch B & W television receiver. Cost of parts used were : one IRC 5.2K resistor @ 25¢; Two Mallory 20 microfarad 600V electrolytic capacitors @ $3.15 each and one RCA 6jE6 horizontal output tube @ $6.19. Cost of the house call and pick-up was $7.00, and the bench man spent 1.5 hours @ $8.50 per hour on the repairs. Calculate the total price to the customer, marking up the parts by 60% from cost.

Complete solutions to B problems

2. Parts	Net Ea.	Markup Ea.	Price
1 ea. 5.2K resistor	$0.25	$0.15	$0.40
2 ea. 20 mfd capacitor	$3.15	$1.89	$10.08
1 ea. 6[illegible]E6 tube	$6.19	$3.71	$ 9.90
House call and Pick-up			$7.00
Shop Labor 1.5 hr @ $8.50 per hour			$12.75
		Total	= $40.13

A. Problems with Solutions

1. A person with practical logging experience wishes to determine the feasibility of going into business for himself. He has located a mill which will guarantee to purchase at least 6 million board feet of camp run logs per year on a regular basis. He has also located a 10 million board foot stand of timber which can be purchased provided he can determine a reasonable figure for stumpage. He would like to purchase a new D7F Caterpillar and include the cost of operation of this machine in his analysis of the logging costs. The following items are pertinent to the problems of determining the amount which can be paid for stumpage and still maintain a reasonable profit margin.

   A. Truck roads are all in with no additional milage required. No road maintenance required.
   B. Work season is expected to be 120 days for this year.
   C. A D7F would be an appropriate size tractor for skidding for this job and for future jobs.
   D. The D7F is to be operated by the owner with one choker setter and should average 50 MBF per 10 hour day.
   E. It is a 3 trip haul to the mill. The trucker is to be paid $165/day and will average 5.5 MBF per load.
   F. Falling and bucking in this area has been going for $4.50 per MBF.
   G. Loading can be contracted for $3.00/MBF.
   H. The mill pays $65/MBF for camp run logs delivered.

   Use the following residual formula to determine the stumpage price. The "profit desired" and risk factor percentages depend on the individual, his experience, and the amount of "unknowns and uncontrollables" on the particular job. 15% and 5% of the logging cost are used for profit and risk factors, respectively, for this problem.

Stumpage = Log selling price - Logging cost + (Profit + Risk)(Logging Cost)

Direct Costs

Direct logging cost per hour are as follows:

D7F Operating Cost	$15.30
Minimum Business Operation Cost	8.65
Labor Cost (Owner & Employee)	14.87
TOTAL	$38.82

A. Problems with Solutions (continued)

1. Solution:

Annual Direct Cost = ($38.82/hr)(1,200 hr) = $46,584

Total MBF = (50 MBF/day)(120 days) = 6,000 MBF

$$\text{Direct Cost per MBF} = \frac{\$46,584}{6,000 \text{ MBF}} = \$7.76 \text{ per MBF}$$

Sub-Contract Costs

Falling and Bucking	$ 4.50 per MBF
Loading	3.00 per MBF
Hauling	10.00 per MBF
Total	$17.50 per MBF

Total Logging Costs is the sum of direct and sub-contract cost = $7.76/MBF + $17.50/MBF = $25.26/MBF

Stumpage Price

Stumpage = Selling Price - [Logging Cost + (Profit + Risk)(Logging Cost)]
= $65.00/MBF - [$25.26/MBF + (15% + 5%)($25.26/MBF)]
= $34.69/MBF

Note: At this stumpage price, there is a $5.05 (20% of the logging cost) allowance for profit and risk. Any stumpage above $34.69 reduces the profit and risk factor. Any price paid above $39.74 reduces the profit to zero and begins to eat into the depreciation and repair reserve.

B. Problems without Solutions

2. Determine the cost of operating the Washington 208F Yarder and Tower, excluding depreciation, taxes and insurance. Assume that the machine is completely rigged and ready to log. Its operation requires six employees at the site whose wages, hours, etc. are itemized below. Assume that fringe benefits, insurance, etc. increase the payroll burden by 30%.

Labor Cost

No.	Title	Rate	Reg Hours	OT	Cost/Day
1	Engineer	$6.00	8	2	
1	Chaser	$5.50	8	2	
3	Chokerman	$5.00	8	2	
1	Hook Tender	$7.00	8	2	
	Total				
	Plus 30% Payroll Burden				
	Total Labor Cost/Day				
	Total Labor Cost/Hour				

Additional Operating Costs (per hour)

Diesel Fuel 20 gph @ $0.21 per gal	
Lube Oil (Crank Case) 0.09 gph @ $1.50 per gal	
Lube Oil (Trans & Final) 0.06 gph @ $1.50 per gal	
Hyd Oil 0.02 gph @ $1.50 per gal	
Filters	$0.12
Grease 0.0616 per hour @ $0.03 per lb	
Repairs (40% of depreciation)	$8.89
Line $20,000/line of 2,000 hour	
Total	
Plus Labor Cost	
Total Operating Cost	

3. If 6 men can plant 10,000 fir seedlings in 5 days with a density of 400 plants per acre, how many acres can 24 men plant in 35 days? Note: This problem can be used to provide an exercise in manipulating dimensioned quantities. The solution can be obtained more easily however by proportion.

3. Problems without Solutions (continued)

4. Determine the approximate cost for constructing 7 miles of fire trail by a bulldozer and a crew of three men. The men and equipment work ten hours each day (two hours overtime) until the work is completed. Their hourly rate of pay is:

$3.50 for one man
$4.12 each for the other two men

All three receive 1 1/2 times their hourly rate for time in excess of 8 hours each day. Cost of the bulldozer is $25 per hour plus $250 transportation. The bulldozer averages 15 chains per hour while building trail. The men are paid a minimum of 8 hour for each day on the job. Neglect time required for transportation and loading or unloading the bulldozer.

5. Aerial application of 3/4 lb of DDT per gallon of fuel oil has been used to control past infestations of the tussock moth. The amount of this solution required per acre is 0.894 gallons. Determine the number of acres which can be treated by a plane which carries 20,000 pounds of the solution. One gallon of the solution weighs 7 lb 15 oz.

2. Labor Cost per Day

For 1 Engineer

$$(\$6.00/\text{hr})(8\text{ hr}) + \left[\$6.00/\text{hr} + (0.5)(\$6.00/\text{hr})\right](2\text{ hr}) = \$66.00$$

For 1 Chaser

$$(\$5.50/\text{hr})(8\text{ hr}) + \left[\$5.50/\text{hr} + (0.5)(\$5.50/\text{hr})\right](2\text{ hr}) = \$60.50$$

For 3 Chokermen

$$(\$5.00/\text{hr})(8\text{ hr}) + \left[\$5.00/\text{hr} + (0.5)(\$5.00/\text{hr})\right](2\text{ hr}) = \$55.00$$
$$(\$55.00/\text{man})(3\text{ men}) = \$165.00$$

For 1 Hook Tender

$$(\$7.00/\text{hr})(8\text{ hr}) + \left[\$7.00/\text{hr} + (0.5)(\$7.00/\text{hr})\right](2\text{ hr}) = \$77.00$$

Total

$$\$66.00 + \$60.50 + \$165.00 + \$77.00 = \$368.50$$

30% Payroll Burden = (0.3)(Total) = (0.3)($368.50) = $110.55

Total Labor Cost/Day = Total + 30% Payroll Burden
= $368.50 + $110.55
= $479.05

$$\text{Total Labor Cost/Hour} = \frac{\text{Total Labor Cost/Day}}{\text{Number of hours worked}}$$

$$= \frac{\$479.05}{10\text{ hr}} = \$47.91/\text{hr}$$

Additional Operating Costs/Hour

Diesel Fuel
(20 gals/hr)($0.21/gal) = $4.20/hr

Lube Oil (Crank Case)
(0.09 gals/hr)($1.50/gal) = $0.14/hr

Lube Oil (Transmission and final)
(0.06 gals/hr)($1.50/gal) = $0.09/hr

Hydraulic Oil
(0.02 gals/hr)($1.50/gal) = $0.03/hr

Filters
$0.12/hr

Grease
(0.0616 lbs/hr)($0.30/lb) = $0.02/hr

Repairs (40% of depreciation)
$8.89/hr

Complete Solutions to B Problems (continued)

2. Continued

Line

$$\frac{\$20{,}000/\text{line}}{2{,}000\ \text{hr/line}} = \$10.00/\text{hr}$$

Total

$4.20/hr + $0.14/hr + $0.09/hr + $0.03/hr + $0.12/hr + $0.02/hr + $8.89/hr + $10.00/hr = $23.48/hr

Total Operating Cost/Hr = Total plus Labor Cost
= 23.48/hr + $47.91/hr
= $71.39/hr

3. Number of plants per day = $\frac{10{,}000\ \text{plants}}{5\ \text{days}}$ = 2,000 plants/day

Number of plants per man per day = $\frac{2{,}000\ \text{plants/day}}{6\ \text{men}}$

= 333.33 plants per man per day

Number of acres planted per man per day = $\frac{333.33\ \text{plants/day}}{400\ \text{plants/acre}}$

= 0.833 acres per man per day

Number of acres for 24 men per day = (0.833 acres/day man)(24 men)
= 20 acres/day

Number of acres planted by 24 men in 35 days = (20 acres/day)(35 days)
= 700 acres

4. Time required = $\frac{\text{length of trail in chains}}{\text{number of chains built each hour}}$

= $\frac{(80\ \text{ch/mi})(7\ \text{mi})}{15\ \text{ch/hr}}$ = 37 1/3 hrs

Time required = three 10-hour days and one 8-hour day
= 32 hours regular time plus 6 hour overtime

Salaries = (32 hrs)($3.50/hr + $4.12/hr + $4.12/hr) = $375.68

Overtime = (6 hrs)(1.5)($3.50/hr + $4.12/hr + $4.12/hr) = $105.66

Total Salaries = $375.68 + $105.66 = $481.34

Equipment = ($25/hr)(37 1/3 hr) = $933.33

Transportation = $250.00

Total = $481.34 + $933.33 + $250.00 = $1,664.67

Complete Solutions to B Problems (continued)

5. Number of gallons per load = $\frac{20{,}000 \text{ lbs}}{7\ 15/16 \text{ lbs/gal}}$ = 2519.7 gals

Number of acres/load = $\frac{\text{number of gallons/load}}{\text{number of gallons/acre}}$

= $\frac{2{,}519.7 \text{ gals/load}}{0.894 \text{ gals/acre}}$

= 2,818 acres/load

A. Problems with solutions.

1. A form must be filled out by a planer mill worker for a 108 piece load of 3 x 6 boards which are 16 feet long. Find the board measure of the load using the following table and formula.

DECIMAL FACTORS FOR BOARD MEASURE

1x2 = .16667	2x2 = .33333	3x3 = .75	4x4 = 1.33333
1x3 = .25	2x3 = .5	3x4 = 1.0	4x5 = 1.66667
1x4 = .33333	2x4 = .66667	3x5 = 1.25	4x6 = 2.0
1x5 = .41667	2x5 = .83333	3x6 = 1.5	4x7 = 2.33333
1x6 = .5	2x6 = 1.0	3x7 = 1.75	4x8 = 2.66667
1x7 = .58333	2x7 = 1.16667	3x8 = 2.0	4x9 = 3.0
1x8 = .66667	2x8 = 1.33333	3x9 = 2.25	4x10= 3.33333
1x9 = .75	2x9 = 1.5	3x10= 2.5	4x11= 3.66667
1x10= .83333	2x10= 1.66667	3x11= 2.75	4x12= 4.0
1x11= .91667	2x11= 1.83333	3x12= 3.0	4x13= 4.33333
1x12= 1.0	2x12= 2.0	3x13= 3.25	4x14= 4.66667
1x13= 1.03333	2x13= 2.16667	3x14= 3.5	4x15= 5.0
1x14= 1.16667	2x14= 2.33333	3x15= 3.75	4x16= 5.33333
1x15= 1.25	2x15= 2.5	3x16= 4.0	4x17= 5.66667
1x16= 1.33333	2x16= 2.66667	3x17= 4.25	4x18= 6.0
1x17= 1.41667	2x17= 2.83333	3x18= 4.5	4x19= 6.33333
1x18= 1.5	2x18= 3.0	3x19= 4.75	4x20= 6.66667
1x19= 1.58333	2x19= 3.16667	3x20= 5.0	4x21= 7.0
	2x20= 3.33333	3x21= 5.25	4x22= 7.33333
	2x21= 3.5	3x22= 5.5	4x23= 7.66667
	2x22= 3.66667	3x23= 5.75	4x24= 8.0
	2x23= 3.33333	3x24= 6.0	
	2x24= 4.0		

$$\text{Board measure} = (\text{number of pieces}) \times \left(\begin{matrix}\text{lineal length} \\ \text{in feet}\end{matrix}\right) \times (\text{decimal factir})$$

Definition: Board foot-- a unit of lumber measurement one foot long, one foot wide, and one inch thick.

Solution: Board measure = (number of pieces)(lineal lengthinft)(decimal factor)

$$= (108 \text{ pieces}) \left(16 \frac{\text{ft}}{\text{piece}}\right) \left(1.5 \frac{\text{bd ft}}{\text{ft}}\right)$$

$$= 2{,}592 \text{ board ft.}$$

2. Find the basis weight of paper in a roll weighing 3910 pounds which contains 22,460 lineal feet having a trimmed width of 66 inches.

$$\text{Basis weight} = \frac{\text{roll weight}}{\left(\frac{\text{lineal feet}}{100}\right)\left(\frac{\text{trim in inches}}{12}\right)}$$

Accuracy: Round the basis weight to the nearest tenth.

A. Problems with solutions, continued.

2. continued.

Definitions: Basis weight - classification of paper related to the thickness of the paper in pounds per 1000 square feet.
Lineal feet - length of the paper
Trim width - width of trimmed paper in inches.

Solution: Basis weight = $\frac{3910 \text{ lbs}}{\left(\frac{22460 \cancel{\text{ ft}}}{100 \cancel{\text{ sq}} \text{ ft}}\right)\left(\frac{66 \cancel{''}}{12 \frac{\cancel{\text{in}}}{\text{ft}}}\right)}$

$= \frac{3910 \text{ lbs}}{\left(\frac{22.46}{\cancel{\text{ ft}}}\right)(5.5 \text{ ft})}$

$= \frac{3910 \text{ lbs}}{123.53}$

$= 31.7 \text{ lbs}$

3. Find the daily production of paper, in bone dry tons, based on the following:

Let M = average per cent moisture free of the paper
B = average basis weight
S = average machine speed in feet per minute
W = average trimmed width in feet
T = machine run time in minutes

Use the following data in the provided formula.

M = 95%
B = 32.37 lbs. per 1000 sq. ft
S = 934.7 ft. per min.
W = $\frac{157.2}{12}$ ft.
T = 1,440 min.

Bone dry tons = $\frac{(M)\ (B)\ (S)\ (W)\ (T)}{2000}$

Accuracy: Round bone dry tons to the nearest tenth of a ton.

Definitions: Basis weight - classification related to the thickness of the paper in pounds per 1000 square feet.

Solution: Substituting into the equation provided.

Bone dry tons = $\frac{(95\%)(32.37 \text{ lb}/1000 \text{ sq ft})(934.7 \text{ ft/min})(1{,}440 \text{ min})}{2{,}000 \text{ lbs/ton}}$

$= \frac{(0.95)(32.37 \cancel{\text{ lbs}}/1000 \cancel{\text{ sq ft}})(12{,}244.57 \cancel{\text{ sq ft/min}})(1{,}440}{2{,}000 \cancel{\text{ lbs}}/\text{ton}}$

= 271.1 bone dry tons

B. Problems without solutions.

4. The plywood industry uses a panel thickness of 3/8" as a standard unit of thickness in combination with the surface area of a panel in determining value of the panel. Find the equivalent surface area for a 4 x 8 panel 1/2" thick which has a conversion factor of 1.33333.

Equivalent surface area = length x width x factor.

Definitions: 4 x 8 panel -- a sheet of plywood 4 feet wide, and 8 feet long.

Surface area-- the product of the length and width.

5. A hardboard plant produced 88 press loads of panels 7/16" thick during a 8 hour shift. Find the 1/8" measure for this production using the following formula, and table.

$$\text{1/8" measure} = \begin{pmatrix}\text{surface measure} \\ \text{of 88 press loads}\end{pmatrix} \times \begin{pmatrix}\text{thickness} \\ \text{conversion factor}\end{pmatrix}$$

surface measure = 112,640 sq ft

THICKNESS CONVERSION FACTORS
1/8th BASIS

THICKNESS	FACTOR	THICKNESS	FACTOR	THICKNESS	FACTOR
.095	1	1/4 pb	2	3/8 std	3
.115	1	1/4 std	2	3/8 prem	3
1/8 pb	1	1/4 prem	2	3/8 cb	3
1/8 std	1	1/4 pl	2		
1/8 prem	1	1/4 cb	2	7/16 LDS	3.5
5/32	1	9/32 qd	2		
		9/32 sd	2.25	1/2	4
3/16 std	1.5				
3/16 pd	1.5	5/16 std	2.5	5/8	5
3/16 pl	1.5	5/16 prem	2.5		
188 cb	1.5				
7/32 cb	1.5				
7/32 pl	1.5				

Definitions: Hardboard -- wood chip fibers combined with chemicals and pressed into a solid panel.
Surface measure -- square feet of panel surface determined by multiplication of length and width.

B. Problems without solutions, continued.

5. continued.

1/8" measure -- standard hardboard measure unit one foot long, one foot wide, and 1/8 inch thick.
Press load -- 20 panels each 50" x 195" and each containing 64 square feet of surface area after trimming.

6. Plywood panels are shipped in standard package loads and the weight of the package must be determined. Use the following weight agreement chart to find the weight of the standard package load for each thickness.

REVISED WEIGHT AGREEMENT NO. 5512

Panel thickness	Weight per Panel	Panels per Package
3/8"	33.6 lbs.	88
1/2"	46.0 lbs.	66
5/8"	56.0 lbs.	53
3/4"	65.5 lbs.	44

B. Problems without solutions.

7. Find the total surface measure and total 1/8" measure for 1925 pieces of 48" x 108" hardboard which have a thickness of 9/32 sd. Use the following formulas.

Surface measure = (number of pieces) x (surface measure per panel)

1/8" measure =(surface measure) x (conversion factor)

Note: For 48" x 108" panels, surface measure equals 36 sq ft per panel.

THICKNESS CONVERSION FACTORS
1/8th BASIS

THICKNESS	FACTOR	THICKNESS	FACTOR	THICKNESS	FACTOR	
.095		1/4 pb	2	3/8 std	3	1
.115		1/4 std	2	3/8 prem	3	1
1/8 pb		1/4 prem	2	3/8 cb	3	1
1/8 std		1/4 pl	2			1
1/8 prem		1/4 cb	2	7/16 LDS	3.5	1
5/32		9/32 gd	2			1
		9/32 sd	2.25	1/2	4	
3/16 std	1.5					
3/16 pb	1.5	5/16 std	2.5	5/8	5	
3/16 pl	1.5	5/16 prem	2.5			
188 cb	1.5					
7/32 cb	1.5					
7/32 pl	1.5					

Definitions:

Hardboard -- wood chip fibers combined with chemicals and pressed into a solid panel.

Surface measure -- square feet of panel surface determined by multiplication of length and width.

1/8" measure -- standard hardboard measure unit one foot long, one foot wide, and 1/8" thick.

B. Problems without solutions.

8. A hardboard plant produced 1056 panels of 7/16" textured hardboard. Each panel contained 64 square feet of surface measure.

a) Find the total surface measure of the 1056 panels.

b) Find the total 1/8" measure of the 1056 panels.

1/8" measure = (surface measure) x (conversion factor)

THICKNESS CONVERSION FACTORS
1/8th BASIS

THICKNESS	FACTOR	THICKNESS	FACTOR	THICKNESS	FACTOR
.095	1	1/4 pb	2	3/8 std	3
.115	1	1/4 std	2	3/8 prem	3
1/8 pb	1	1/4 prem	2	3/8 cb	3
1/8 std	1	1/4 pl	2		
1/8 prem	1	1/4 cb	2	7/16 LDS	3.5
5/32	1	9/32 gd	2		
		9/32 sd	2.25	1/2	4
3/16 std	1.5				
3/16 pb	1.5	5/16 std	2.5	5/8	5
3/16 pl	1.5	5/16 prem	2.5		
118 cb	1.5				
7/32 cb	1.5				
7/32 pl	1.5				

Definitions : Hardboard -- wood chip fibers combined with chemicals and pressed into a solid panel.
Textured hardboard -- panels having a design which is pressed onto its surface.
1/8" measure -- standard hardboard measure unit one foot long, one foot wide, and one- eighth inch thick.

B. Problems without solutions..

9. A shipment of 1x2 lumber consisted of three different grades as follows: 829 pieces SEL MEACH, 1190 pieces #1 MEACH, 349 pieces #2 MEACH. (See tally sheet below). Find the board footage for each grade and the total being shipped.

DECIMAL FACTORS FOR BOARD MEASURE

1x2 = .16667	2x2 = .33333	3x3 = .75	4x4 = 1.33333
1x3 = .25	2x3 = .5	3x4 = 1.0	4x5 = 1.66667
1x4 = .33333	2x4 = .66667	3x5 = 1.25	4x6 = 2.0
1x5 = .41667	2x5 = .83333	3x6 = 1.5	4x7 = 2.33333
1x6 = .5	2x6 = 1.0	3x7 = 1.75	4x8 = 2.66667
1x7 = .58333	2x7 = 1.16667	3x8 = 2.0	4x9 = 3.0
1x8 = .66667	2x8 = 1.33333	3x9 = 2.25	4x10= 3.33333
1x9 = .75	2x9 = 1.5	3x10= 2.5	4x11= 3.66667
1x10= .83333	2x10= 1.66667	3x11= 2.75	4x12= 4.0
1x11= .91667	2x11= 1.83333	3x12= 3.0	4x13= 4.33333
1x12= 1.0	2x12= 2.0	3x13= 3.25	4x14= 4.66667
1x13= 1.03333	2x13= 2.16667	3x14= 3.5	4x15= 5.0
1x14= 1.16667	2x14= 2.33333	3x15= 3.75	4x16= 5.33333
1x15= 1.25	2x15= 2.5	3x16= 4.0	4x17= 5.66667
1x16= 1.33333	2x16= 2.66667	3x17= 4.25	4x18= 6.0
1x17= 1.41667	2x17= 2.83333	3x18= 4.5	4x19= 6.33333
1x18= 1.5	2x18= 3.0	3x19= 4.75	4x20= 6.66667
1x19= 1.58333	2x19= 3.166667	3x20= 5.0	4x21= 7.0
	2x20= 3.33333	3x21= 5.25	4x22= 7.33333
	2x21= 3.5	3x22= 5.5	4x23= 7.66667
	2x22= 3.66667	3x23= 5.75	4x24= 8.0
	2x23= 3.33333	3x24= 6.0	
	2x24= 4.0		

Board footage = (number of pieces) x (lineal length in feet) x (decimal factor)

Definition: Board footage -- total number of board feet (a unit of lumber measurement one foot long, one foot wide, and one inch thick.

Ordered pieces	ft	shipped pieces	description	6	8	10	12	14	16	18	20
			Lot B -883 7pkgs								
			SEL MEACH								
		829	1 x 2 #1 MEACH				379	349			101
		1190	1 x 2 #2 MEACH				542	504			144
		349	1 x 2				159	147			43

Complete solutions to 8 problems.

4. Equivalent surface area = (length) (width)(factor)

Substituting supplied values:

Equivalent surface area = (4')(8')(1.33333')

= 42.66656 units.

5. 1/8" measure = $\begin{pmatrix}\text{surface measure} \\ \text{of 88 press loads}\end{pmatrix}\begin{pmatrix}\text{thickness} \\ \text{conversion factor}\end{pmatrix}$

Substituting supplied values

1/8" measure = (112,640 sq ft) (3.5)

= 394,240 units.

6. Package weight =(weight per panel)(panels per package)

Panel thickness	Package weight
3/8"	$\left(33.6 \frac{\text{lbs}}{\cancel{\text{panel}}}\right)\left(88 \frac{\cancel{\text{panels}}}{\text{package}}\right) = 2{,}956.8 \frac{\text{lbs}}{\text{package}}$
1/2"	$\left(46.0 \frac{\text{lbs}}{\cancel{\text{panel}}}\right)\left(66 \frac{\cancel{\text{panels}}}{\text{package}}\right) = 3{,}036 \frac{\text{lbs}}{\text{package}}$
	$\left(56.0 \frac{\text{lb}}{\cancel{\text{panel}}}\right)\left(53 \frac{\cancel{\text{panels}}}{\text{package}}\right) = 2{,}968 \frac{\text{lbs}}{\text{package}}$
	$\left(65.5 \frac{\text{lb}}{\cancel{\text{panel}}}\right)\left(44 \frac{\cancel{\text{panels}}}{\text{package}}\right) = 2{,}882 \frac{\text{lbs}}{\text{package}}$

7. Surface measure = (number of pieces) (surface measure per panel)

= (1925 ~~pieces~~) $\left(36 \frac{\text{sq ft}}{\cancel{\text{piece}}}\right)$

= 69,300 sq ft

1/8" measure = (surface measure) (conversion factor)

= (69,300 sq ft) (2.25)

= 155,925

Complete solution to B problems.

8. A) Surface measure = (number of panels) (surface measure per panel)

$$= (1056 \text{ panels}) \left(64 \frac{\text{sq ft}}{\text{panel}}\right)$$

$$= 67{,}584 \text{ sq. ft.}$$

b) 1/8" measure = (surface measure) (conversion factor)

$$= (67{,}584 \text{ sq. ft}) (3.5)$$

$$= 236{,}544$$

9. Board feet = (number of pieces) (lineal length in feet) (decimal factor)

For sel MEACH $= (379 \text{ pieces}) \left(12 \frac{\text{ft}}{\text{piece}}\right) (.16667) = 758.01515$

$(349 \text{ pieces}) \left(14 \frac{\text{ft}}{\text{piece}}\right) (.16667) = 814.34962$

$(101 \text{ pieces}) \left(20 \frac{\text{ft}}{\text{piece}}\right) (.16667) = 336.67340$

For #1 MEACH $= (542 \text{ pieces}) \left(12 \frac{\text{ft}}{\text{piece}}\right) (.16667) = 1084.02168$

$(504 \text{ pieces}) \left(14 \frac{\text{ft}}{\text{piece}}\right) (.16667) = 1176.02352$

$(144 \text{ pieces}) \left(20 \frac{\text{ft}}{\text{piece}}\right) (.16667) = 480.00960$

For #2 MEACH $= (159 \text{ pieces}) \left(12 \frac{\text{ft}}{\text{piece}}\right) (.16667) = 318.00636$

$(147 \text{ pieces}) \left(14 \frac{\text{ft}}{\text{pieces}}\right) (.16667) = 343,00686$

$(43 \text{ pieces}) \left(20 \frac{\text{ft}}{\text{pieces}}\right) (.16667) = 143.33520$

+

Total Board Feet 5453.44239

A. Problems with Solutions

1. Complete the following stand evaluation summary for a timber sale in the Ochoco National Forest.

Diameter Inside Bark	Volume (M Bd ft) Douglas Fir Log Grades			Total Volume
	1	2	3	
9	0.122	1.819	1.747	
12	0.559	4.905	3.748	
15	1.364	4.739	3.558	
18	.257	4.164	4.435	
21		9.382	5.174	
24	.407	3.330	2.333	
27		2.191	3.095	
30		1.397	0.949	
Total				

Solution:

To obtain the total volume of grade one we add 0.122 MBF + 0.559 MBF + 1.364 MBF + .257 MBF + .407 MBF = 2.709 MBF

Similarly the totals for grade 2 and 3 are 31.927 MBF and 25.039 MBF, respectively.

To obtain the total of 9 inch DIB we add 0.122 MBF + 1.189 MBF + 1.747 MBF = 3.688 MBF. Similarly the other totals in the column on the right are 9.212 MBF, 9.661 MBF, 8.856 MBF, 14.556 MBF, 6.070 MBF, 5.286 MBF and 2.346 MBF.

The grand total can be cross checked by adding the horizontal totals:

2.709 MBF + 31.927 MBF + 25.039 MBF = 59.675 MBF

And the vertical totals:

9.212 MBF + 9.661 MBF + 8.856 MBF + 14.556 MBF + 6.070 MBF + 5.286 MBF + 2.346 MBF = 59.675 MBF.

A. Problems with Solutions (continued) mwd.

2. Definition: The number of feet rise vertically per 100 feet on the horizontal is called percent slope.

Formulas:

$$\text{Per Cent Slope} = \frac{\text{diff. in elevation} \times 100}{\text{horizontal distance}}$$

a) What is the per cent slope if the difference in elevation is 42 ft and the horizontal distance is 150ft?

b) For a vertical rise of 21.9ft and a horizontal distance of 250 feet what would be the per cent slope?

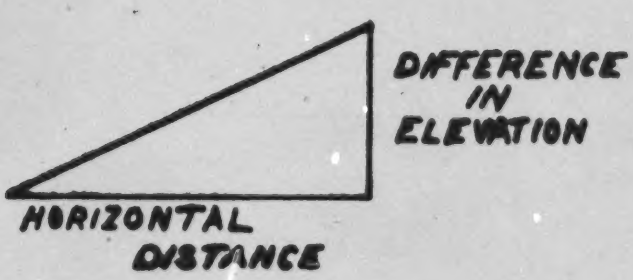
c) The horizontal distance along a 4.5% slope is 200 ft. What is the difference in elevation?

Solution:

a) Per Cent Slope = $\frac{42\text{ft}\ (100)}{150\text{ ft}}$ = 28%

b) Per Cent Slope = $\frac{21.9\text{ft}\ (100)}{250\text{ft.}}$ = 8.76%

c) .045 (200ft) = 9ft.



A. Problems with Solutions (continued)

3. A common method of determining costs involved in forest road construction is to determine the cost/MBF of timber harvested (MBF denotes million bd-ft). For each of the following items, determine the cost/MBF for a timber sale of 1,530 MBF.

   a) Blading and ditch cleaning can be done at the rate of $40/mile. For this sale 6.8 miles of road will require 1 blading and 3.3 miles of road will require two bladings.

   b) 6.5 miles of temporary roads will require work at the rate of $200/mile.

   c) Work on a temporary log bridge will require a D-7 cat and operator for 9 hours at $24/hr and an additional man at $3.75/hr for 8 hours.

   Solutions:

   a) $(6.8\ \cancel{mi})(\$40/\cancel{mi}) + (2\ \text{bladings})(3.3\ \cancel{mi}/\cancel{\text{blading}})(\$40/\cancel{mi}) =$

   $\$272 + \$264 = \$536 \qquad \frac{\$536}{1{,}530\ \text{MBF}} = \$0.35/\text{MBF}$

   b) $\frac{(6.5\ \cancel{mi})(\$200/\cancel{mi})}{1{,}530\ \text{MBF}} = \frac{\$1{,}300}{1{,}530\ \text{MBF}} = \$0.85/\text{MBF}$

   c) $\frac{(9\ \cancel{hr})(\$24/\cancel{hr}) + (8\ \cancel{hr})(\$3.75/\cancel{hr})}{1{,}530\ \text{MBF}} = \frac{\$216 + \$30}{1{,}530\ \text{MBF}}$

   $= \frac{\$246}{1{,}530\ \text{MBF}}$

   $= \$0.16/\text{MBF}$

B. Problems without solutions.

4. Complete the following chart which is construction cost estimates for a road in a timber sales area in the Ochoco National Forest. (Round each answer to nearest dollar)

Description	Unit	UnitPrice	No. Units	Cost (nearest dollar)
Clearing & Grubbing	acre	$1482	11.6	
Disposal	acre	$392	11.6	
Excavation	cu.yd	$1.77	26717	
Surfacing-Produce	cu.yd	$2.12	10821	
Surfacing-Process	cu.yd	$.57	10821	
Haul	yd.mi	$.24	31381	
Base Course-Produce	cu.yd	$2.02	10028	
Base Course-Process	cu.yd	$.57	10028	
Haul	yd.mi	$.25	28078	
15" Metal Culvert	linft	$5.50	186	
18" Metal Culvert	"	$5.80	80	
24" Metal Culvert	"	$9.40	22	
Rip Rap	cu.yd	$20.0	5	
Oil Dust	ton	$55.	68	
Seed,Fert., Mulch	acre	$300.	7.8	
Total				

5. In constructing a new spur road with moderate heavy clearing necessary the following information is available:
Clear & Pile Slash; D-7 (.25 mi/day) @ $175/day
Construct and roughgrade; D-7 (1.0 mi/day) @ $175/day
Finish Blade; Grader (4.0 mi/day) @ $120/day
Final Blade; Grader (3.0 mi/day) @ $120/day

a) Determine the total cost/mile.
b) Determine the cost of constructing 10.2 miles of National Forest spur road.

B. Problems without solutions, continued.

6. A logged area in the Ochoco National Forest is to be planted with a grass mixture as follows:

Species	No. seeds/sq.ft @ 1 lb/acre	lb/acre	cost/lb
Crested Wheatgrass	4.0	5	$.33
Pubescent Wheatgrass	2.1	6	$.85

a) Determine the total cost of each species of 89 acres of the above mixture is planted.
b) What would be the total cost of the above planting?
c) Determine the number of seeds/sq.ft for each species for the above planting.

7. A logged area will be replanted with a grass mixture as follows:

Species	lb/acre	cost/lb
Intermediate Wheatgrass	6	$.41
Tall Oatgrass	4	$.75
Brangrass	3	$.26

a) Determine the total cost of planting 174 acres using the above mixture.
b) In replanting the acre it is determined that there would be 2.3 seeds/sq ft of Intermediate Wheatgrass if seed were distributed at the rate of 1 lb/acre and similarly 3.0 seeds/sq ft of Oatgrass and 2.9 seeds/sq ft of brangrass. If the mix is distributed as indicated, how many seeds/sq ft could we expect of each of the three species?

B. Problems without solutions, continued.

8. A local wood products company purchased the following at a National Forest timber sale:

   1) 2,400,000 board feet of Douglas Fir at $120.69 per 1000 board feet.

   2) 1.900,000 board feet of white fir at a price of $71.05 per 1000 board feet.

   3) $94.25 per 1000 board feet for 6,200,000 board feet of Ponderosa Pine.

   4) Deposits of $6.85 per 1000 board feet will be made for slash disposal and $1.09 per 1000 board feet for road maintenance.

Determine

a) the total volume of timber sold.
b) the price paid for Ponderosa Pine.
c) the total price paid for all timber sold.
d) total deposits necessary for slash disposal & road maintenance.

9. For a timber sale in the Deschutes National Forest the following information is available.

round trip hauling time	80min.
loading time	30min.
weighing station time	2 min.
unloading time	13min.

a) If the net operating time is $11\frac{1}{2}$hr per day how many round trips/day are possible?
B) Assuming that all time over $7\frac{1}{2}$ hr is overtime, how many hours overtime will be needed for each driver?
c) Determine the daily pay of each driver if his rate of pay is $12.42/hr straight time and $14.46 overtime?
d) If an average load contains 5.0 MBF determine the daily haul volume/driver and cost/MBF.

B. Problems without solutions, continued.

10. A parcel of cut-over land is to be reforested with Douglas Fir. A seed dealer offers 4000 lbs of seed at $16 per pound with a stated purity of 98%, a germination of 80% and a moisture content of 8%.

a) What total price is the dealer asking?

b) Determine the percentage of pure live seed (PLS) using the formula $\left(\frac{(P)\ (G)}{100}\right)$ where P is the 5% purity and G is the 5% of germination.

c) Since only a percentage (partB) of the seed is pure live seed determine the dealers true price/lb for the seed.

d) Lab tests showed the seed at a purity of 97%, a germination of 75% and a moisture content of 10%. Determine the lab PLS using the formula in part b.

e) Determine the actual seed value by multiplying the Lab PLS by the dealers true price/lb.

4. In each case multiplying the unit price by the number of units obtaining respectively: \$17,191; \$4,547; \$47,289; \$22,941; \$6,168; \$7,531; \$20,257; \$5,716; \$7,020; \$1,023; \$464; \$207; \$100; \$3,740 and \$2,340.
Adding those a total of \$146,534 is obtained.

5. a) clear & pile slashes (\$175/day)(1 day/0.25 mi) = \$700/mi
const & rough grade (\$175/day)(1 day/1 mi) = \$175/mi
finish blade (\$120/day)(1 day/4 mi) = \$30/mi
final blade (\$120/day)(1 day/3 mi) = \$40/mi

b) (\$945/mi)(10.2 mi) = \$9,639.00

6. a) Crested Wheatgrass

(89 acres)(5 lb/acre)(\$0.33/lb) = \$146.85

Pubescent Wheatgrass

(89 acres)(6 lb/acre)(\$0.85/lb) = \$453.90

b) \$146.85 + \$453.90 = \$600.75

c) Crested Wheatgrass

$$\left(\frac{4 \text{ seeds/sq ft}}{\text{lb/acre}}\right)(5 \text{ lbs/acre}) = 20 \text{ seeds/sq ft}$$

Pubescent Wheatgrass

$$\left(\frac{2.1 \text{ seeds/sq ft}}{\text{lb/acre}}\right)(6 \text{ lb/acre}) = 12.6 \text{ seeds/sq ft}$$

7. a) Cost of Wheatgrass = (6 lbs/acre)(\$0.41/lb)(174 acres) = \$428.04

Cost of Tall Oatgrass = (4 lbs/acre)(\$0.75/lb)(174 acres)
= \$522.00

Cost of Brangrass = (3 lb/acre)(\$0.26/lb)(174 acres) = \$135.73

Total cost of grasses = \$428.04 + \$522.00 + \$135.72 = \$1,085.76

b) Wheatgrass = (2.3 seeds/sq ft)(6) = 13.8 seeds/sq ft

Oatgrass = (3.0 seeds/sq ft)(4) = 12.0 seeds/sq ft

Brangrass = (2.9 seeds/sq ft)(3) = 8.7 seeds/sq ft

Complete Solutions to B Problems, continued

8. a) Timber sold = 2,400,000 bd ft + 1,900,000 bd ft + 6,200,000 bd ft
=10,500,000 bd ft

b) Price paid for Ponderosa Pine = $\left(\frac{6,200,000 \text{ bd ft}}{1,000 \text{ bd ft}}\right)(\$94.25)$

= $584,350

c) Total price = $584,350 + $\frac{(2,400,000 \text{ bd ft})(\$120.69)}{1,000 \text{ bd ft}}$ +

$\frac{(1,900,000 \text{ bd ft})(\$71.05)}{1,000 \text{ bd ft}}$

= $584,350 + $289,656 + $134,995
= $1,009,001

d) Deposit for slash disposal = $\frac{(10,500,000 \text{ bd ft})(\$1.09)}{1,000 \text{ bd ft}}$

= $71,925

Deposit for road maintenance = $\frac{(10,500,000 \text{ bd ft})(\$1.09)}{1,000 \text{ bd ft}}$

= $11,445

9. a) Round trips possible = $\frac{(17.5 \text{ hr/day})(60 \text{ min/hr})}{(80 \text{ min} + 30 \text{ min} + 2 \text{ min} + 13 \text{ min})/\text{round trip}}$

= 5 round trips/day (round off to a whole number of trips)

b) Overtime = 11.5 hr/day - 7.5 hr/day = 4 hr/day

c) Daily pay = (7.5 hr)($12.42/hr) + (4 hr)($14.46/hr)
= $93.15 + $57.84
= $150.99

d) Haul volume = (5 loads/driver)(5.0 MBF/load)
= 25 MBF/driver

Cost = $\frac{\$150.99}{25 \text{ MBF}}$ = $6.04/MBF

Level 3

Complete Solutions to B Problems (continued)

10. a) Total price = (4000 ~~lbs~~)($16/~~lb~~) = $64,000

b) Live seed = $\frac{(98)(80)}{100}$ = 78.4%

c) Dealers true price:

0.784B lb = $16

B = $16/0.784 lb

= $20.41/lb

d) Lab PLS = $\frac{(97)(75)}{100}$ = 72.75%

e) Actual seed value = (0.7275)($20.41) = $14.85/lb

DECIMALS
Level I

Nursing

A. Problems with solutions.

1. Write the following in decimals:

a) 5/10 = _____
b) 25/100 = _____
c) 25/1000 = _____
d) 3 3/4 = _____

Solution: To solve these, simply divide.

a. 5/10 = 0.50 b. 25/100 = 0.25 c. 25/1000 = 0.025

d. 3 3/4 = 15/4 = 3/75

2. a. 14.5 + 0.07 + 1.009 =
b. 50.0 + 150.5 =
c. 0.75 + 315.75 =
d. 0.917 + 247.59 =
e. 0.027 + 0.07344 =
f. 0.015 + 6.000 =
g. 4875 37.5 =

Solution:

a. 15.579
b. 200.50
c. 316.50
d. 248.507
e. 0.10044
f. 6.015
g. 130.00

3. The doctor ordered 0.3 mg of Atropine by hypo. You have Atropine gr 1/150 per 1 cc ampules. How much would you give (to the nearest tenth cc)?

Solution:

$$\frac{1}{50} \text{ grains} = 0.40 \text{ mg}$$

$$\frac{0.40 \text{ mg}}{1.0 \text{ cc}} = \frac{0.30 \text{ mg}}{N \text{ cc}}$$

$$(N\text{cc})(0.40 \text{ mg}) = (0.30 \text{ mg})(1.0\text{cc})$$

$$(N\text{cc}) = \frac{(0.30 \text{ mg})(1.0\text{cc})}{0.40 \text{ mg}}$$

$$N = 0.75 \text{ cc}$$

$$\doteq 0.8 \text{ cc}$$

B. Problems without solutions.

4. Epinephrine (Adrenalin) ampule is labeled 1 mg in/cc. The order is to give 0.2 mg. You would give _____ minims

5. The doctor ordered 10 mg. of phenergan. The ampule on hand is labeled 25 mg/cc. How much would you give (to the nearest tenth cc)?

6. The doctor has ordered 0.5 gm of medication to be given. The drug is supplied in 15 gr scored tablets. How much will you give?

7. The doctor orders 60 mg of a drug. It is supplied in a 100 mg per 2 cc vial. How much would you give (to the nearest tenth cc)?

B. Problems without solutions.

8. A patient is to receive 1500 cc of an IV liquid over a period of 8 hours. How many cc's is this per minute? (nearest tenth)

9. A doctor requests a dosage of 100 mg of phenobarbital. The ampule reads 1 cc = 130 mg (2 gr).

   How many cc's should be drawn (to the nearest tenth?)

10. The dosage of Quabain needed to be given to a patient is 0.2 mg. The ampule reads 0.5 mg/2cc.

    How many cc's need to be drawn?

Complete solutions to B problems.

4. $\frac{1 \text{ mg}}{1 \text{ cc}} = \frac{0.20 \text{ mg}}{N}$, therefore N = 0.20 cc

$$\left(\frac{0.20 \text{ cc}}{1}\right)\left(\frac{60 \text{ minim}}{1 \text{ cc}}\right) = 12 \text{ minim}$$

5. $\frac{25 \text{ mg}}{1 \text{ cc}} = \frac{10 \text{ mg}}{N}$

$$(25 \text{ mg})(N) = (10 \text{ mg})(1 \text{ cc})$$

$$N = \frac{(10 \text{ mg})(1 \text{ cc})}{25 \text{ mg}}$$

$$= 0.4 \text{ cc}$$

6. 0.5 gm = 7.5 grains

$$\frac{7.5 \text{ grains/dose}}{15 \text{ grains/tablet}}$$

= 0.5 tablet/dose

7. $\frac{100 \text{ mg}}{2 \text{ cc}} = \frac{60 \text{ mg}}{N \text{ cc}}$

$$(100 \text{ mg})(N\text{cc}) = (60 \text{ mg})(2 \text{ cc})$$

$$N\text{cc} = \frac{(60 \text{ mg})(2 \text{ cc})}{100 \text{ mg}}$$

$$= 1.2 \text{ cc}$$

8. $\left(\frac{1500 \text{ cc}}{8 \text{ hrs}}\right)\left(\frac{1 \text{ hr}}{60 \text{ min}}\right) = 3.1 \text{ cc/min}$

Complete solutions to B problems.

9. $\frac{1 \text{ cc}}{130 \text{ mg}} = \frac{N}{100 \text{ mg}}$

$(130 \text{ mg})(N) = (100 \text{ mg})(1 \text{ cc})$

$N = \frac{(100 \text{ mg})(1 \text{ cc})}{130 \text{ mg}}$

$N = 0.77 \text{ cc}$

$\doteq 0.8 \text{ cc}$

10. $\frac{0.5 \text{ mg}}{2 \text{ cc}} = \frac{0.2 \text{ mg}}{N}$

$(0.5 \text{ mg})(N) = (0.2 \text{ mg})(2 \text{ cc})$

$N = \frac{(0.2 \text{ mg})(2 \text{ cc})}{0.5 \text{ mg}}$

$= 0.8 \text{ cc}$

A. Problems with Solutions

1. Chet's Chicken Inn sells chicken dinners at $1.95 per serving. If there is $421.20 in the register at the end of the day, how many dinners were served that day? (Assume that all income is from chicken dinners.)

Solution:

$$\frac{\$421.20}{\$1.95/\text{dinner}} = \frac{(\$421.20)(\text{dinner})}{\$1.95} = 216 \text{ dinners}$$

2. Compute the total value of the following stocks:

10 shares of Wolf Oil @ 16 3/8 _____

100 shares of 3rd Nat Bank @ 52 3/8 _____

150 shares of United Auto @ 12 1/8 _____

Total _____

Solution:

Shares of stock are priced in dollars and eighths of dollars. For example: 12 1/8 means $12.125.

(10 ~~shares~~)($16.375/~~share~~) = $163.75

(100 ~~shares~~)($52.375/~~share~~) = $5,237.50

(150 ~~shares~~)($12.125/~~share~~) = $1,818.75

Total = $163.75 + $5,237.50 + $1,818.75 = $7,220.00

3. An article that cost $13.25 was sold for $18.50. What decimal part of the selling price was the profit?

Solution:

First find the amount of profit:

Profit = $18.50 - $13.25 = $5.25

To get the decimal part of the selling price:

$$\frac{\$5.25}{\$18.50} = 0.28, \text{ correct to two decimals}$$

A. Problems with Solutions (continued)

4. After being damaged by fire, goods valued before the fire at $1,800 were sold at a reduction of 0.25. What was the selling price?

Solution:

Selling price = price before fire - reduction

= $1,800 - ($1,800)(0.25)

= $1,800 - $450 = $1,350

B. Problems without Solutions

5. The cost of manufacturing 4,500 pegs was $3.06. What was the cost (a) per peg, (b) for 1,000 pegs (c) what would the selling price be for 10,000 pegs if 1/3 of the selling price is profit?

6. A grocery dealer bought potatoes at various times during the year as follows: 35 bushels at $0.95 per bushel, 50 bushels at $0.83 per bushel, 25 bushels at $1.15 per bushel and 65 bushels at $0.70 per bushel. Find the average cost per bushel for all the potatoes bought.

B. Problems without Solutions (continued)

7. The F. E. Davis Company purchased 2,500 ft of wire at a cost of $0.1575 per foot and 5 boxes of bolts at a cost of $1.625 per box. Compute the total purchase cost and round the answer to the nearest cent.

8. Find the cost of sending the following shipment of boxes by freight when the rate between the two cities is 82.14¢ per hundred-weight. The boxes weigh as follows: 216 lbs, 429 lbs, 176 lbs, and 314 lbs.

9. In a 50" wide fabric it takes 11 yards to cover a couch and 6 yards to cover a chair. An upholsterer has a contract to cover 15 suites of furniture, each consisting of a couch and two chairs. How many 46-yard rolls of material must he buy?

B. Problems without Solutions (continued)

10. A merchant buys beans at $16 per hundred pounds and sells them in 4-lb sacks at 95¢ per sack. What is his profit (a) per pound, and (b) per hundred pounds?

11. Ten thousand copies of a 416 page book are to be printed on paper which weighs 120 lb per ream (500 sheets) and costs 16¢ per lb. Making no allowance for waste, find the cost of the paper needed for printing if 32 book-size pages can be obtained from <u>each side</u> of the 36 x 48 inch sheets.

12. A customer bought 2 7/8 yds of satin priced at $2.75 per yard and 5 1/4 yds of muslin at $1.80 per yard. What should the customer be charged?

B. Problems without Solutions (continued)

13. The Analy Market has 3 cash registers. Sales for each on a particular day during a typical hour were as follows: Register No. 1: $3.04, $0.79, $15.67, $32.50, $1.00, $22.66, $19.65, $0.91, and $10.16; Register No. 2: $37.89, $11.99, $5.60, $11.27, $41.20, $8.86, and $10.01; Register No. 3: $20.06, $52.00, $17.89, $5.89, $6.03, $14.56, $27.16, and $30.09. Find the total sales for each register and the total sales for all three registers.

14. Joe Smith earns $3.80 an hour. His company pays time and one-half for hours in excess of 8 per day and/or 40 hours per week. Sunday hours are paid at double time. Last week Joe worked the following hours: Monday, 8; Tuesday, 9; Wednesday, 8; Thursday, 10 1/2; Friday, 8; Saturday, 3; Sunday, 4. How much did he earn before deductions?

15. An article sold for $37.50 yielding a profit of 0.25 of the cost. What is the cost?

Complete Solutions to B Problems

5. (a) Cost per peg = $\frac{\text{total cost}}{\text{total pegs}}$

$= \frac{\$3.06}{4{,}500 \text{ pegs}} = \$0.00068/\text{peg}$

(b) Cost of 1,000 pegs = (\$0.00068/peg)(1,000 pegs) = \$0.68

(c) Selling price = cost + profit

Cost of 10,000 pegs = (\$0.00068/peg)(10,000 pegs) = \$6.80

Since the profit is 1/3 of the selling price, then the cost must be 2/3 of the selling price.

(2/3)(selling price) = \$6.80

Selling price = (\$6.80)(3/2) = \$10.20

6. Total cost = (35 bu)(\$0.95/bu) + (50 bu)(\$0.83/bu) + (25 bu)(\$1.15/bu) + (65 bu)(\$0.70/bu)

= \$33.25 + \$41.50 + \$28.75 + \$45.50 = \$149.00

Total bushels = 35 bu + 50 bu + 25 bu + 65 bu = 175 bu

Average cost = $\frac{\$149.00}{175 \text{ bu}}$ = \$0.85/bu

7. Cost of wire = (2,500 ft)(\$0.1575/ft) = \$393.75

Cost of bolts = (5 boxes)(\$1.625/box) = \$8.125

Total purchase cost = \$393.75 + \$8.125 = \$401.875

= \$401.88 when rounded to nearest cent

8. Total weight = 216 lbs + 429 lbs + 176 lbs + 314 lbs = 1,135 lbs

Expressed in hundreds of lbs $\frac{1{,}135 \text{ lbs}}{100}$ = 11.35 hundred lbs

Shipping cost = (11.35 hundred lbs)(\$0.8214/hundred lbs)

= \$9.32

Complete Solutions to B Problems (continued)

9. Number of couches to cover = 15

Number of chairs to cover = 30

Total yardage required = (15 couches)(11 yds/couch) + (30 chairs)(6 yds/chair)

= 165 yds + 180 yds = 345 yds

Rolls needed = $\frac{345 \text{ yds}}{46 \text{ yds/roll}}$ = 7.5 rolls

He must buy 8 rolls of material

10. (a) Profit per lb = selling price per lb - cost per lb

Selling price per lb = $\frac{\$0.95}{4 \text{ lbs}}$ = \$0.2375/lb

Cost per lb = $\frac{\$16.00}{100 \text{ lbs}}$ = \$0.16/lb

Profit per lb = \$0.2375/lb - \$0.16/lb = \$0.0775/lb

(b) Profit per 100 lbs = (100 lbs)(profit per lb)

= (100 lbs)(\$0.0775/lb) = \$7.75

11. Total book-size pages to be printed = (10,000 copies)(416 pages/copy)

= 4,160,000 pages

Total "big" sheets needed = $\frac{4{,}160{,}000 \text{ pages}}{(32 \text{ pages/side})(2 \text{ sides/sheet})}$

= 65,000 sheets

Total reams needed = $\frac{65{,}000 \text{ sheets}}{500 \text{ sheets/ream}}$ = 130 reams

Total weight = (130 reams)(120 lbs/ream) = 15,600 lbs

Cost = (15,600 lbs)(\$0.16/lb) = \$2,496

Complete Solutions to B Problems (continued)

12. Total customer charge = cost of satin + cost of muslin
= (2 7/8 yds)($2.75/yd) + (5 1/4 yds)($1.80/yd)
= (2.875 yds)($2.75/yd) + (5.25 yds)($1.80/yd)
= $7.91 + $9.45 = $17.36

13. Add the entries from each register:

Register No. 1	Register No. 2	Register No. 3
$ 3.04	$ 37.89	$ 20.06
.79	41.20	52.00
15.67	11.99	17.89
32.50	5.60	5.89
1.00	11.27	6.03
22.66	8.86	14.56
19.65	+ 10.01	27.16
10.16	$126.82	+ 30.09
+ .91		$173.68
$106.38		

Total sales = $106.38 + $126.82 + $173.68 = $406.88

14. Total time worked monday thru Saturday:

8 hrs + 9 hrs + 8 hrs + 10.5 hrs + 8 hrs + 3 hrs = 46.5 hrs

Total pay = (40 hrs)($3.80/hr) + (6.5 hrs)($3.80/hr)(1.5) +
(4 hrs)($3.80/hr)(2)
= $152.00 + $37.05 + $30.40
= $219.45

15. Selling price = cost + profit

$37.50 = cost + (0.25)(cost)
$37.50 = (1.25)(cost)

$\frac{\$37.50}{1.25}$ = cost

$30.00 = cost

Rule of Thumb Gauging Method

This is a 3 compartment rig, so upon checking the truck's gauging chart we find, to arrive at the amount of brine and finally cherries and brine, the compartments must gauge these depths:

	Compartment	Depth	Gallons	
Brine only -	1 (end)	16.5 inches	300	
	2 (center)	18.0 inches	590	
	3 (end)	16.5 inches	300	
		Total	1190	gallons of brine
Cherries and Brine -	1 (end)	29.5 inches	735	
	2 (center)	35.5 inches	1470	
	3 (end)	29.5 inches	735	
		Total	2940	gallons of brine and cherries

The truck and trailer must both be weighed after adding the brine and adding the cherries to determine the weight of cherries shipped.

A. Problems with Solutions

1. The total amount of cherries and brine combined is computed as follows: Total net capacity (truck of trailer) divided by 8.5 (weight of cherries and brine equals gallons of cherries and brine.) If the net capacity of a trailer is 25,000 pounds, what is the total number of gallons of cherries and brine?

   Solution:

   $$\text{Cherries and brine} = \frac{25{,}000 \text{ lbs}}{8.5 \text{ lbs/gal}} = 2{,}941.2 \text{ gal}$$

2. In 1973 sweet corn brought $38 per ton delivered to the cannery. Grower Schmidt delivered a 14,760 pound load of sweet corn and received a 7% dock. What will grower Schmidt receive for this truckload?

   Solution:

   $$\text{Pounds paid} = (14{,}760 \text{ lbs})(0.93) = 13{,}726.8 \text{ lbs}$$

   $$\text{Schmidt receives} = \frac{(13{,}726.8 \text{ lbs})(\$38/\text{ton})}{2{,}000 \text{ lbs/ton}} = \$260.81$$

A. Problems with Solutions (continued)

3. An average 1000 pound steer will yield about 590 pounds of carcass or 465 pounds of retail cuts. If the packer pays $395 for the steer and the retailer pays $465, the consumer must pay about $560 to cover mark-up, rent, labor, trim loss, depreciation, etc.

   If the yield is: Porterhouse, T-bone and club steak is 35 lbs @ 2.89, 40 lbs of sirloin @ $1.89, 65 lbs of round steak @ $1.19, 45 lbs of rib roast @ $0.89, 25 lbs of boneless rump roast @ $1.09, 100 lbs of chuck roast @ $0.89, 45 lbs of hamburger @ $0.75 and stew meat with miscellaneous cuts weighing 110 lbs @ $0.65; how much per pound will the meat cutter have to receive for 125 lbs of bones and fat to account for the $560 consumer total?

   Solution:

(35 lbs)($2.89/lb)	=	$101.15
(40 lbs)($1.89/lb)	=	75.60
(65 lbs)($1.19/lb)	=	77.35
(45 lbs)($0.89/lb)	=	40.05
(25 lbs)($1.09/lb)	=	27.25
(100 lbs)($0.89/lb)	=	89.00
(45 lbs)($0.75/lb)	=	33.75
(110 lbs)($0.65/lb)	=	71.50
		$515.65

   Received by meat cutter to cover consumer total:

$$\frac{\$560 - \$515.65}{125 \text{ lbs}} = \frac{\$44.35}{125 \text{ lbs}} = \$0.355/\text{lb}$$

B. Problems without Solutions

4. This is a three compartment truck:

	Compartment	Depth	Gallons
Brine only	1 (end)	16.5 inches	300
	2 (center)	18.0 inches	590
	3 (end)	16.5 inches	300
Cherries and Brine	1 (end)	29.5 inches	735
	2 (center)	35.5 inches	1470
	3 (end)	29.5 inches	735

(a) What are the total gallons of brine?

(b) What are the total gallons of brine and cherries?

(c) What is the net weight of cherries on this truck?

DEFINITIONS

Brine = 8.42 lbs per gallon
Brine and cherries = 8.52 lbs per gallon
Rule of Thumb: (net gallons of cherries in brine)(8.588) = net lb of cherries

5. The charge for an acre-foot of water in 1973 was $4.50 per acre foot pumped out of ditches in the Santiam bean area. If Grower Barleson pumped 3.25 acre feet on each 64 acres, what would the cannery pay the Mill Creek water district for this water Barleson pumped?
DEFINITIONS: An acre foot is enough water to cover an acre, one foot deep or 43,560 cu ft of water.

B. Problems without Solutions (continued)

6. If 54.96 ml of nectar weighs 52.78 grams, what is the specific gravity of the nectar?

DEFINITIONS: Specific gravity is density of a substance referred to the density of water.

54.96 ml of water weighs 54.96 grams at 3.98 C.

7. The data below represents an actual truckload of cherries:

Data I	Con Frtwys Load #5	
	Trailer No. 567-82	
	Gross Trailer wt	35,450
	Trailer Tare	10,600
Data II	Truck #517-81	
	Truck Gross wt	39,700
	Truck Tare	19,400

The trailer was filled to depth of 20.5 inches with brine, which represents 1190 gallons at 8.4 pounds per gallon. Likewise the truck was filled to depth 20.5 inches with brine, but this represents 981 gallons at 8.4 pounds per gallon. Cherries were dumped into both the truck and trailer to bring the level to 40 inches. What is the total weight of the cherries on this truck-trailer combination?

B. Problems without Solutions (continued)

8. The Salem formula for brine is 17 lbs of anhydrous sodium bisulfite, 7.5 lbs of anhydrous calcium chloride and 12 fluid ounces of concentrated hydrochloric acid added to water to make 100 gallons of brine. The average brine tank holds 7500 gallons of brine. How much of each of the above ingredients is required for 7500 gallons of brine?

9. In 1973 strawberries were 23¢ per pound. The average production per acre in the North Howell district was 5.63 tons. The average dockage rate was 4.38%. Estimate the cannery's payment to a grower with 10.78 acres in this district. (Dockage is the deduction for unusable product.)

Level 2

10. The formula for silver nitrate is Ag NO_3. (Ag) Silver weighs 108 grams, (N) nitrogen weighs 14 grams and (O) oxygen weighs 16 grams. The subscript 3 indicates that Oxygen is present three times.

    The term gram molecular weight and gram-equivalent are equal in the case of Ag NO_3. This solution will be used for salt content determinations. How much does one liter of 0.1 normal silver nitrate solution weigh?

B. Problems without Solutions (continued)

11. A cold storage plant's system can remove 5.92×10^6 B.T.U. per 24 hours.

    (a) What is the rating of this system in tons of refrigeration?

    (b) How many tons of green beans brought in from a temperature of 85°F can be cooled to 35°F in 24 hours?

    DEFINITIONS: B.T.U. = the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit. 288,000 B.T.U. = 1 TON of Refrigeration. Heat of respiration of green beans is about 90,000 B.T.U. per ton per 24 hours.

12. Determine the total weight of a syrup vat to be installed on the second floor (to provide gravity flow to various fillers). The syrup vat and plumbing weighs 7,348 pounds empty. The maximum weight the vat will hold is 1538 gallons of syrup with a specific gravity of 1.2485.

    DEFINITIONS: One gallon of water at 40°F weighs 8.339 pounds.

B. Problems without Solutions (continued)

13. A bottle of carbonated drink had a gas pressure of 45 pounds per square inch at 70°F.

    (a) How many volumes of carbon dioxide are in this bottle?

    (b) If you run 15,000 bottles of 7 ounces each, how many volumes (expressed as cubic feet) of carbon dioxide would you use?

    DEFINITIONS: Any Fahrenheit degree can be converted to Fahrenheit absolute scale by adding 459.69. Standard pressure = 14.7 lbs per sq in. One cubic foot = 1000 ounces.

14. In 1973 sieve size 1 through 4 green beans were $145 per ton and sieve size 5 and 6 were $70 per ton. The dockage rate was between 10% and 30%.

    Grower Jones's truck has a gross weight of 47,250 pounds, the truck weighs 28,130 pounds and remainder is green beans.

    Your sample indicate a 17% dock and the cannery will pay on the remainder on the basis of 82%, one through 4 sieve and 18% 5 and 6 sieve. What will grower Jones receive for this truck load?

Complete Solutions to B Problems (continued)

4. (a) Brine = 300 gals + 590 gals + 300 gals = 1,190 gals

(b) Cherries and brine = 735 gals + 1,470 gals + 735 gals = 2,940 gals

(c) Net weight of cherries = (2,940 gals)(8.52 lbs/gal) - (1,190 gals)(8.42 lbs/gal)

= 25,048.8 lbs - 10,019.8 lbs
= 15,029 lbs

5. Cannery paid = (3.25 acre-ft/acre)(64 acres)($4.50/acre-ft)

= $936.00

6. Specific gravity = $\frac{52.78\ g}{54.96\ g}$ = 0.9603

7. Net weight of cherries and brine in trailer:
35,450 lbs - 10,600 lbs = 24,850 lbs

Net weight of cherries and brine in truck:
39,700 lbs - 19,400 lbs = 20,300 lbs

Brine in trailer = (1,190 gals)(8.4 lbs/gal) = 9,996 lbs

Brine in truck = (981 gals)(8.4 lbs/gal) = 8,240 lbs

Cherries = (24,850 lbs - 9,996 lbs) + (20,300 lbs - 8,240 lbs)
= 14,854 lbs + 12,060 lbs
= 26,914 lbs

8. Need 75 times the given amount to make 7500 gallons of brine.

Anhydrous sodium bisulfite = (17 lbs)(75) = 1,275 lbs

Calcium chloride = (7.5 lbs)(75) = 562.5 lbs

Hydrochloric acid = (12 oz)(75) = 900 oz

Complete Solutions to B Problems (continued)

9. Gross tons = (10.78 ~~acres~~)(5.63 tons/~~acre~~) = 60.69 tons

Net tons = (60.69 tons)(0.9562) = 58.03 tons

Payment to grower = (58.03 ~~tons~~)($0.23/~~lb~~)(2,000 ~~lbs/ton~~)
= $26,693.80

Level 2

10. One liter of normal = Ag + N + 3O

= 108g + 14g + 3(16g)
= 108g + 14g + 48g
= 170g

One liter of 0.1 normal = (170g)(0.1) = 17g

11. (a) Rating = $\frac{5{,}920{,}000\ \text{~~BTU~~/day}}{288{,}000\ \text{~~BTU~~/ton}}$ = 20.56 tons per day

(b) x number of tons of beans

Temperature lowered = 85° - 35° = 50°

(50)(2000)x = 5,920,000
(100,000)x = 5,920,000
x = 59.2 tons/day

12. Maximum weight = 7,348 lbs + (1,538 ~~gals~~)(8.339 lbs/~~gal~~)(1.2485)
= 7,348 lbs + 16,012.49 lbs
= 23,360.49 lbs

13. (a) Volumes of CO_2 = $\left(\frac{45\ \text{~~lbs/sq in~~}}{14.7\ \text{~~lbs/sq in~~}}\right)\left(\frac{459.69}{529.69}\right)$ = 2.657

(b) CO_2 = $\frac{(15{,}000\ \text{~~bottles~~})(7\ \text{~~oz/bottle~~})(2.657)}{1{,}000\ \text{~~oz~~/cu ft}}$

= 278.99 cu ft

Complete Solutions to B Problems (continued)

14. Net weight of beans = 47,250 lbs - 28,130 lbs
= 19,120 lbs

Pounds to be paid = (19,120 lbs)(0.83) = 15,869.6 lbs

Size 1 through 4 = (15,869.6 lbs)(0.82) = 13,013 lbs

Size 5 and 6 = 15,869.6 lbs - 13,013 lbs = 2,856.6 lbs

$$\text{Total received} = \left(\frac{13{,}013 \text{ lbs}}{2{,}000 \text{ lbs/ton}}\right)(\$145/\text{ton}) + \left(\frac{2{,}856.6 \text{ lbs}}{2{,}000 \text{ lbs/ton}}\right)(\$70/\text{ton})$$

$$= (6.5065 \text{ ton})(\$145/\text{ton}) + (1.4283 \text{ ton})(\$70/\text{ton})$$

$$= \$943.44 + \$99.98$$

$$= \$1{,}043.42$$

A. Problems with solutions.

1. A steer whose live weight was 1,120 lbs, dressed out at 684 lbs. The dressed weight was what part of the live weight? Express the result as a decimal to the nearest hundredth.

Solution: $\frac{684 \text{ lbs.}}{1120 \text{ lbs.}} = .61$

2. How many acres can be plowed in 10 hours by a tractor traveling 6 mph and pulling 5-16 inch bottom plow? (Assume .05 lost time).

Solution: Total width of plow = (5)(16in.) = $(80\text{in.})\left(\frac{1 \text{ ft}}{12 \text{ in.}}\right) = 6.67$ feet

$$(6.67 \text{ ft})\left(\frac{5{,}280 \text{ ft}}{\text{mile}}\right)\left(\frac{6 \text{ miles}}{\text{hour}}\right)(10 \text{ hours})\left(\frac{1 \text{ acre}}{43{,}560 \text{ ft}^2}\right) =$$

$= 48.5$ acres

3. It is necessary to pump 4.2 acre-feet of water each day into an irrigation resevoir 175 feet above the river. If we assume no friction or other losses in the process the minimum power required to do this job is _____ hp.

1 h.p. = 33,000 ft. lb/min.

1 acre-foot = 325,900 gallons

1 gallon = 8.35 lbs.

Solution:

$$\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{(\text{force})\ (\text{distance})}{\text{Time}} =$$

$$\left(\frac{4.2 \text{ acre-foot}}{\text{day}}\right)\left(\frac{325{,}900 \text{ gal}}{\text{acre-foot}}\right)\left(\frac{8.35 \text{ lb}}{\text{gal.}}\right)(175 \text{ feet})\left(\frac{1 \text{ day}}{24 \text{ hour}}\right)$$
$$\left(\frac{1 \text{ hour}}{60 \text{ min.}}\right)\left(\frac{1 \text{ hp}}{\frac{33{,}000 \text{ ft. lbs.}}{\text{min.}}}\right) = 42.1 \text{ hp.}$$

4. A truck bed is (8')(14') (6') in size. The driver goes to Portland loaded level (full) with wheat. On the return trip he brings back an equal weight of plywood having a specific gravity of 0.78. He can therefore bring back how many pieces of (4')(8')(1") plywood?

Note: 1 bushel of wheat weighs 60 lbs, 1 bushel = 0.8036 cu ft

A. Problems with solutions, continued.

4. Solution:

Volume : (8 ft) (14 ft) (6 ft) = 672 ft^3

Weight of wheat : (672 ft^3) $\left(\frac{0.8036 \text{ bu}}{1 \text{ ft}^3}\right)\left(\frac{60 \text{ lbs}}{1 \text{ bu}}\right)$ = 32,401.2 or 32,400 lbs.

Weight of 1 ft^3 plywood : $\left(\frac{62.4 \text{ lbs}}{ft^3}\right)$ (.78) = 48.7 lbs/ft^3

1 piece of plywood : (4 ft) (8 ft) (1 in) $\left(\frac{1 \text{ ft}}{12 \text{ in}}\right)$ = 2.67 ft^3/piece

$$\left(\frac{48.7 \text{ lbs}}{ft^3}\right)\left(\frac{2.67 \text{ ft}^3}{\text{piece}}\right) = \frac{130 \text{ lbs}}{\text{piece}}$$

$$\frac{32{,}400 \text{ lbs}}{\left(\frac{130 \text{ lbs}}{\text{piece}}\right)} = 249 \text{ pieces}$$

B. Problems without solutions.

5. If 14,386 lbs. of cotton lint are produced on 34.2 acres, what is the yield per acre, expressed to the nearest hundredth of a pound?

6. Calculate the weight of wheat in a full truck, 20.2 feet long, 6.9 feet wide, and 4.3 feet high. How many bushels would it hold?

7. If a man wants to apply 20 gallons per acre of spray and he can cover .24 acres per minute, what should be the discharge rate in gallons per hour?

8. In fertilizer used on corn land, 0.425 of the mixture is cotton seed meal, 0.45 is phosphoric acid and the rest is kainit. How many pounds of each are there in a ton of the fertilizer?

B. Problems without solutions.

9. A Leghorn laying hen requires 35 lbs. of mash and 50 lbs. of grain per year. With mash costing $9.00 per hundred-weight and grain costing $7.86 per hundred-weight , how many eggs worth 68¢ per dozen must a hen lay in a year to pay for her feed bill?

10. If the length of the sides of a four sided field are 478.3 ft, 597.6 feet, 392.1 feet and 801.9 feet, what will it cost to fence the field at $1.435 per rod? How many posts will it take, if none are placed more than 16 feet apart?

11. It is estimated that 635 lbs. of shelled corn will produce 100 lbs. of live-weight pork or that a combination of 275 lbs. of shelled corn, 35 lbs. of tankage and 20 lbs. of cotton-seed meal will produce the same weight. If shelled corn is worth $7.23 per hundredweight, tankage is worth $13.00 per hundredweight and cottonseed meal is worth $9.00 per hundredweight which would be the most economical feed? How much would you save in cost per hundred pounds of live weight gain?

B. Problems without solutions.

12. In tests to compare net returns from calves, yearlings and 2 year olds, the following data was found:

	Calves	yearlings	2 year olds
gain per day	2.19 lbs.	2.26 lbs.	2.40 lbs.
days fed	197	174	162
feed cost/100#gain	$27.14	$28.96	$29.14
selling price	$38.32	$38.08	$38.14
purchase cost/100#	$40.00	$38.38	$38.50
purchase weight	754 lbs.	843 lbs.	985 lbs.

Find the net return from each.

B. Problems without solutions.

13. To the nearest tenth of a square inch, how large a plot of ground would it take to produce enough wheat to make a 22.5 ounce loaf of bread? Assume the field has a 80 bu/acre yield, 1.38 pounds of wheat makes 1 lb. of flour and that 1 lb. of flour makes 1.65 pounds of bread.

14. The following mixture of feeds makes 1000 lbs, of a standard baby chick ration:

Ingredients	Cost/lb.
325 lbs. ground yellow corn	$.065
275 lbs. gray wheat shorts	$.096
100 lbs. ground oats	$.092
80 lbs. dried buttermilk	$.175
70 lbs. meat scraps	$.123
50 lbs. cottonseed meal	$.078
40 lbs. alfalfa leaf meal	$.082
34 lbs. bran	$.053
15 lbs. finely ground shell	$.020
10 lbs. salt	$.010
1 pint triple-strength cod liver oil	$7.30 per gal.

This same feed can be bought ready-mixed at $11.25 per hundred-weight. Disregarding the cost of labor, how much can the farmer save per ton by mixing instead of buying ready-mixed?

B. Problems without solutions.

14. continued.

15.

Tractor	Fuel	H.P.	Gal/hr.
1	Gas	61.25	6.704
2	Propane	61.73	8.615
3	Diesel	61.92	5.109

Using the tractors listed above, find (a) the HP-hr per gallon, (b) lbs/HP-hr, and (c) the percent thermal efficiency for each.

B. Problems without solutions.

16. One current idea in agriculture is the use of sprinkler systems for frost protection. If water at 45°F is applied to an area of 500 ft. by 300 ft. at the rate of .09 inches of water per hour and it freezes, attaining a final temperature of 32°F, how many BTU's are liberated per hour? If we assume the heat is retained in a layer of air 100 ft. deep, that the specific heat of air is o.242 BTU/lb-°F and that the specific weight of air is .080 lb/ft^3, the heat liberated per hour could raise the air temperature how many degrees?

5. $\frac{14{,}386 \text{ lbs}}{34.2 \text{ acre}} = 420.65 \frac{\text{lbs}}{\text{acre}}$

6. Volume : (20.2 ft)(6.9 ft) (4.3 ft) = 599.3 ft^3

(599.3 ~~ft^3~~) $\left(\frac{0.8036 \text{ bu}}{1 \text{ ~~ft}^3}\right)$ = 481.6 bu.

(481.6 ~~bu~~) $\left(\frac{60 \text{ lbs.}}{\text{~~bu.}}\right)$ = 28,897 lbs.

7. $\left(\frac{20 \text{ gallons}}{\text{~~acre}}\right)\left(\frac{.24 \text{ ~~acres}}{\text{~~min.}}\right)\left(\frac{60 \text{ ~~min.}}{\text{hour}}\right) = \frac{288 \text{ gallons}}{\text{hour}}$

8. Cottonseed meal : (2,000)(0.425) = 850 lbs.

Phosphoric acid : (2,000)(0.45) = 900 lbs.

Kainit : 2,000 - (850 + 900) = 2,000 - 1,750 = 250 lbs

9. $\left(\frac{\$9.00}{\text{~~hundred}}\right)$ (.35 ~~hundred~~) = $3.15

$\left(\frac{\$7.86}{\text{~~hundred}}\right)$ (.50 ~~hundred~~) = $3.93

$3.15 + $3.93 = $7.08

$\$7.08 \div \left(\frac{\$.68}{\text{~~dozen}} \times \frac{1 \text{ ~~dozen}}{12 \text{ eggs}}\right) = \$7.08 \div \frac{\$.68}{12 \text{ eggs}} = (\$7.08)\left(\frac{12 \text{ eggs}}{\$.68}\right)$ =

124.9 or 125 eggs.

10. 478.3 feet + 597.6 feet + 392.1 feet + 801.9 feet =

(2269.9 ~~feet~~) $\left(\frac{1 \text{ rod}}{16.5 \text{ ~~ft.}}\right)$ = (137.6 rods) $\left(\frac{\$1.435}{\text{rod}}\right)$ = $197.41

$\frac{478.3}{16}$ = 29.9 = 30 posts

$\frac{597.6}{16}$ = 37.4 = 37 posts as one corner post from above

$\frac{392.1}{16}$ = 24.5 = 24 posts as one corner post from above

$\frac{801.9}{16}$ = 50.1 = 50 posts as one corner post from above

Total $\overline{141}$ posts

Complete solutions to B problems, continued.

11. $(635\ \text{lbs})\left(\frac{\$7.23}{100\ \text{lbs.}}\right) = \$45.91$

$(275\ \text{lbs.})\left(\frac{\$7.23}{100\ \text{lbs}}\right) + (35\ \text{lbs.})\left(\frac{\$13.00}{100\ \text{lbs}}\right) + (20\ \text{lbs})\left(\frac{\$9.00}{100\ \text{lbs}}\right) =$

$\$19.88 + \$4.55 + \$1.80 = \$26.23$

Combination is most economical.
$\$45.91 - \$26.23 = 19.68$ (saved per hundred pounds of live weight gain.)

12. Calves:

$\left(\frac{\$38.32}{100\ \text{lbs}}\right)\left((754\ \text{lbs.}) + (197\ \text{days})\left(\frac{2.19\ \text{lbs.}}{\text{day}}\right)\right) - \left(\left(\frac{2.19\ \text{lbs}}{\text{day}}\right)(197\ \text{days})\right)$

$\left(\frac{\$27.14}{100\ \text{lbs}}\right) + \left(\frac{\$40.00}{100\ \text{lbs}}\right)(754\ \text{lbs}) = \left(\frac{\$38.32}{100\ \text{lbs}}\right)(754\ \text{lbs} + 431.43\text{lbs}) -$

$(\$117.09 + \$301.60) = \left(\frac{\$38.32}{100\ \text{lbs}}\right)(1185.43\ \text{lbs.}) - (\$418.69) =$

$\$454.26 - \$418.69 = \$35.57$ profit

Yearlings:

$\left(\frac{\$38.08}{100\ \text{lbs.}}\right)\left((843\ \text{lbs} + (174\ \text{days})\left(\frac{2.26\ \text{lbs}}{\text{day}}\right)\right) - \left(\left(\frac{2.26\ \text{lbs}}{\text{day}}\right)(174\ \text{day})\right)$

$\left(\frac{\$28.96}{100\ \text{lbs}}\right) + \left(\left(\frac{\$38.38}{100\ \text{lbs.}}\right)(843\ \text{lbs})\right) = \left(\frac{\$38.08}{100\ \text{lbs}}\right)(843\ \text{lbs} + 393.24\ \text{lbs}) -$

$(\$113.89 + \$323.55) = \left(\frac{\$38.08}{100\ \text{lbs.}}\right)(1236.24\ \text{lbs.}) - (437.44) =$

$\$470.76 - \$437.43 = \$33.33$ profit.

2 Year olds:

$\left(\frac{\$38.14}{100\ \text{lbs}}\right)\left((985\ \text{lbs.} + (162\ \text{days})\left(\frac{2.40\ \text{lbs}}{\text{day}}\right)\right) - \left(\left(\frac{2.40\ \text{lbs.}}{\text{day}}\right)(162\ \text{days})\right)$

$\left(\left(\frac{\$29.14}{100\ \text{lbs}}\right)\right) + \left(\left(\frac{\$38.50}{100\ \text{lbs}}\right)(985\ \text{lbs.})\right) =$

$\left(\frac{\$38.14}{100\ \text{lbs}}\right)(1373.80\ \text{lbs}) - (\$492.53) =$

$\$523.97 - \$492.52 = \$31.45$ profit

Complete solutions to B problems, continued.

13. $\left(\frac{1 \text{ acre}}{80 \text{ bu}}\right)\left(\frac{1 \text{ bu}}{60 \text{ lbs. wheat}}\right)\left(\frac{1.38 \text{ lbs. wheat}}{1 \text{ lb. flour}}\right)\left(\frac{1 \text{ lb flour}}{1.65 \text{ lbs. bread}}\right)$

$\left(\frac{1 \text{ lb}}{16 \text{ oz}}\right)\left(\frac{22.5 \text{ oz}}{1 \text{ loaf}}\right)\left(\frac{43{,}560 \text{ ft}^2}{1 \text{ acre}}\right)\left(\frac{144 \text{ in}^2}{1 \text{ ft}^2}\right) = 1537.0$ sq. in.

14.

(325 lbs)	($.065/lbs)	=	$21.125
(275 lbs)	($.096/lbs)	=	$26.40
(100 lbs)	($.092/lbs)	=	$ 9.20
(80 lbs)	($.175/lbs)	=	$14.00
(70 lbs)	($.123/lbs)	=	$ 8.61
(50 lbs)	($.078/lbs)	=	$3.90
(40 lbs)	($.082/lbs)	=	$ 3.28
(34 lbs)	($.053/lbs)	=	$ 1.802
(15 lbs)	($.020/lbs)	=	$ .30
(10 lbs)	($.010/lbs)	=	$ .10

$(1 \text{ pt})\left(\frac{1 \text{ gal}}{8 \text{ pt.}}\right)(\$7.30) = \$ .9125$

$\$89.6295$ per 1,000 pounds

Ready-mixed:

$\left(\frac{\$11.25}{100 \text{ lbs}}\right)\left(\frac{2{,}000 \text{ lbs}}{\text{ton}}\right) = \$225.00/\text{ton}$

$\left(\frac{\$89.6295}{1{,}000 \text{ lbs}}\right)\left(\frac{2{,}000 \text{ lbs}}{\text{ton}}\right) = \$179.26/\text{ton}$

savings = $45.74/ton

15. Tractor 1:

a) $\frac{61.25 \text{ HP}}{6.704 \text{ gal/hr}} = 9.136 \frac{\text{HP-hr.}}{\text{gal.}}$

b) $\left(\frac{1 \text{ gal}}{9.136 \text{ HP-hr}}\right)\left(\frac{6.15 \text{ lbs}}{\text{gal}}\right) = .673 \frac{\text{1 lb.}}{\text{HP-hr.}}$

c) $\left(\frac{\text{output}}{\text{input}}\right)(100\%) = \left(\frac{(61.25 \text{ HP})\left(\frac{42.44 \text{ BTU/min}}{\text{HP}}\right)\left(\frac{60 \text{ min}}{\text{hr}}\right)}{(6.704 \text{ gal/hr})\ (124{,}300 \text{ BTU/gal.})}\right)$

$(100\%) = \left(\frac{155{,}967}{833{,}307}\right)(100\%) = 18.72\%$

Complete solutions to B problems, continued.

15. Tractor 2:

a) $\frac{61.73 \text{ HP}}{8.615 \text{ gal/hr.}} = 7.165 \frac{\text{HP-hr.}}{\text{gal.}}$

b) $\left(\frac{1 \text{ gal}}{7.165 \text{ HP./hr}}\right)\left(\frac{7.061 \text{ lbs}}{\text{gal}}\right) = .985 \frac{1 \text{ lb.}}{\text{HP-hr.}}$

c) $\left(\frac{\text{output}}{\text{input}}\right)(100\%) = \left(\frac{(61.73 \text{ HR})\left(\frac{42.44 \text{ BTU/min}}{\text{HP}}\right)\left(\frac{60 \text{ min}}{\text{hour}}\right)}{(8.615 \text{ gal/hr.})\ (138{,}380 \text{ BTU/ gal.})}\right)$

$(100\%) = \left(\frac{157{,}189}{1{,}192{,}144}\right)(100\%) = 13.19\%$

Tractor 3:

a) $\left(\frac{61.92 \text{ HP}}{5.109 \text{ gal/hr.}}\right) = 12.120 \frac{\text{HP-hr.}}{\text{gal.}}$

b) $\left(\frac{1 \text{ gal}}{12{,}120 \text{ HP-hr}}\right)\left(\frac{4.25 \text{ lbs}}{\text{gal.}}\right) = .351 \frac{1 \text{ lb.}}{\text{HP- hr}}$

c) $\left(\frac{\text{output}}{\text{input}}\right)(100\%) = \left(\frac{(61.92 \text{ HP})\left(\frac{42.44 \text{ BTU/min}}{\text{HP}}\right)\left(\frac{60 \text{ min}}{\text{hour}}\right)}{(5{,}109 \text{ gal/hr/})\ (92{,}300 \text{ BTU/gal.})}\right)(100\%)$

$\left(\frac{157{,}673}{471{,}560}\right)(100\%) = 33.44\%$

16. water

Volume : (500 ft) (300ft) $\left(\frac{.09 \text{ inches}}{\text{hour}}\right)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right) = \frac{1125 \text{ ft}^3}{\text{hour}}$

Mass: $\left(\frac{1125 \text{ ft}^3}{\text{hour}}\right)\left(\frac{7.48 \text{ gal}}{1 \text{ ft}^3}\right)\left(\frac{8.35 \text{ lbs}}{1 \text{ gal.}}\right) = 70265 \frac{\text{lbs}}{\text{hour}}$

Heat loss: (45-32) $\left(70265 \frac{\text{lbs}}{\text{hour}}\right) + \left(70265 \frac{\text{lbs}}{\text{hour}}\right)\left(80 \frac{\text{BTU}}{\text{lbs.}}\right) =$

$6{,}534{,}645 \frac{\text{BTU}}{\text{hour}}$

air

Volume : (500 ft) (300ft) (100ft) = 15,000,000 ft.^{3} air

Mass: (15,000,000 ft^3) $\left(\frac{.080 \text{ lbs}}{\text{ft}^3}\right) = 1{,}200{,}000$ lbs.

$\left(\frac{6{,}535{,}110 \text{ BTU/hour}}{0.242 \text{ BTU/lb} - \text{F}}\right)\left(\frac{1}{1{,}200{,}000 \text{ lbs}}\right) = 22.5^{\circ} \text{ F/hour}$

A. Problems with Solutions

1. The effluent at the Willow Island plant is chlorinated at the rate of 250 pounds per day. In checking the recorded flow for a one day run, the following log was created:

TIME	MGD	TIME	MGD
0000	1.23	1200	2.24
0200	0.78	1400	3.15
0400	0.65	1600	2.85
0600	1.75	1800	2.25
0800	2.53	2000	1.95
1000	2.78	2200	1.86

What was the average chlorine dosage-expressed in ppm?

Solution:

$$\text{Average flow} = \frac{1.23 \text{ MGD} + 0.78 \text{ MGD} + 0.65 \text{ MGD} + 1.75 \text{ MGD}}{12} + \frac{2.53 \text{ MGD} + 2.78 \text{ MGD} + 2.24 \text{ MGD} + 3.15 \text{ MGD}}{12} + \frac{2.85 \text{ MGD} + 2.25 \text{ MGD} + 1.95 \text{ MGD} + 1.86 \text{ MGD}}{12}$$

$$= \frac{24.02 \text{ MGD}}{12} = 2.00 \text{ MGD}$$

1 gallon = 8.34 lbs

$$\text{ppm} = \frac{250 \cancel{\text{lbs/day}}}{(8.34 \cancel{\text{lbs}})(200 \text{ MG}/\cancel{\text{day}})} = 14.99$$

2. A treatment plant discharges effluent with a DO of 2.2 ppm into a stream having a DO of 5.9 ppm and a flow of 153 cfs. If the discharge rate is 17.75 MGD, what is the resultant DO in the stream?

Solution:

(cfs)(0.6462) = MGD
(153)(0.6462) = 98.87 MGD flow in stream
(98.87)(5.9) = 583.32 effective DO in stream
(17.75)(2.2) = 39.05 effective DO in effluent
17.75 + 98.87 = 116.62 effective flow downstream

$$\frac{\text{effective DO in stream + effective DO in effluent}}{\text{effective flow downstream}} = \text{ppm}$$

$$\frac{583.32 + 39.05}{116.62} = 5.34 \text{ ppm}$$

A. Problems with Solutions (continued)

3. The flow in a sewer line is 1.55 MGD. What is this flow when expressed as cfs?

Solution:

(a) If one uses such tables as CRC, they find that there are 7.48 gallons per cubic foot. Using this and the fact that there are 86,400 seconds in a day, we arrive at the following solution:

$$\frac{(1.55 \text{ MGD})(1{,}000{,}000)}{(7.48)(86{,}400)} = 2.398 \text{ cfs}$$

(b) As conversion from MGD to cfs is so common place in this work STP people use 7.5 gallons/cu ft and a little eye-ball round-off to come up with the following conversion factor:

$$(\text{MGD})(1.55) = \text{cfs}$$

Note: By accurate calculation the conversion factor is
1.54733 using 7.48 gal/cu ft and
1.5432 using 7.5 gal/cu ft

So, by using the conversion factor of 1.55 (as used) the problem becomes (1.55)(1.55) = 2.4025 cfs

B. Problems without Solutions

4. Well digested sludge has a specific gravity of 1.035. Calculate in tons the weight of a bed of wet sludge 50 feet by 30 feet which is 15 inches thick. (Note: a cubic foot of water weighs 1,000 ounces avd.)

5. Many wastewater-treatment plants have realized they have a saleable commodity in their sludge. Assume a charge of $1.25 per yard for sludge delivered by the plant and calculate the charge for a load of 4.5 yards.

B. Problems without Solutions (continued)

6. Two 60-foot (I.D) trickling filters receive 15.675 MGD of primary effluent, containing 175 mg/l BOD. Filter effluent contains 33 ppm BOD. How many pounds BOD are removed each day at these stated levels?

7. An aerator has a volume of 52,375 cubic feet. If the flow is 1.53 MGD, what is the retention time in the aerator?

8. The hypochlorite you are using has 41.7 percent available chlorine. At what figure - in pounds per day - would you set the feed rate of the chlorinator if you lab tests show that you need to feed 13 mg/l and you know the flow rate to be 0.75 MGD?

9. What is the DO at a point one day downstream from a treatment plant which discharges 5.5 MGD of plant effluent with a one day BOD of 625 pounds and zero DO into the stream having zero BOD, a DO of 7.9 mg/liter, and a flow of 23 MGD?

B. Problems without Solutions (continued)

10. A sample of digested sludge is placed in an evaporating dish, weighed, placed in a desiccator, weighed, placed in a muffle furnace, cooled, and re-weighed. The data recorded for this analysis is:

Empty dish	36.97 grams
Dish and sludge	95.83 grams
Dish after drying	42.37 grams
After ignition	39.26 grams

(a) What was the percent of solids in the sludge?
(b) What was the percent of volatile solids in the sample?

Solution:

11. Fifty ml of sewage is filtered through a Gooch crucible, carefully prepared and weighed. The crucible is then dried, cooled, weighed, placed in a muffle furnace, re-cooled, and re-weighed. The weights recorded at various stages of the analysis are:

Empty crucible	35. 3268 grams
After drying	35.3447 grams
After filtering	35.3695 grams
After ignition	35.3298 grams

(a) What is the total weight of suspended solids in the sample?
(b) What is the weight of volatile solids in the sample?
(c) What percent of the sample is non-volatile?

Solution:

B. Problems without Solutions (continued)

12. Reproduced below is a chlorine chart for a six day period at Salmon Creek wastewater plant.

	Sun	Mon	Tues	Wed	Thur	Fri
Cl reading	802	665	533	380	242	108
Cl lbs/day						

(a) What poundage of chlorine was applied to the wastestream each day of the regular work week?
What was the average chlorine pounds applied?

(b) With an average daily flow of 5.9 MGD and an average chlorine residual of 1 ppm, what the average chlorine demand of the wastestream?

Solution:

B. Problems without Solutions (continued)

13. The following is a partial sludge pumping record for the month of July at the Salmon Creek wastewater plant:

date	start of pumping	end of pumping	pumped	daily total
1st	8:10 a.m. 2:05 p.m.	8:40 a.m. 2:41 p.m.		
2nd	8:20 a.m. 2:56 p.m. 9:30 p.m.	8:50 a.m. 3:20 p.m. 9:42 p.m.		

(a) Determine the quantities pumped for each pumping interval and the daily total from the data above, using the following schedule located near the plunger pump.

hr	gals	hr	gals
0.1	545	0.7	3815
0.2	1090	0.8	4360
0.3	1635	0.9	4905
0.4	2180	1.0	5450
0.5	2725	1.1	5995
0.6	3270	1.2	6540

(b) The plunger pump operates at 50 rpm. How many gallons of sewage sludge are pumped per revolution?

(c) The plunger pump has a 9" bore (diameter). What is the stroke?

Solution:

B. Problems without Solutions (continued)

14. The primary digester measures 32' square and is filled to a depth of 21.5'. The population served by the treatment plant is 20,000. What is the digester volume per capita?

Solution:

Complete Solutions to B Problems

4. The first thing one should note is the mixture of units stated in the problem. Most wastewater people would know that a cubic foot of water weighs 62.5 pounds and would not bother with the 1000 oz as given. One need merely calculate the volume of the sludge, find the weight of that much water and then multiply by the specific gravity, as s.g. is the weight of a substance compared to water as unity.

(50)(30)(1.3) = volume in cubic feet
(Volume)(62.5)(1.035) = weight of sludge in pounds

$$\frac{(50)(30)(1.33)(62.5)(1.035)}{2{,}000} = 64.69$$

5. ($1.25/~~cu yd~~)(4.5 ~~cu yd~~) = $5.63

6. One milligram per liter is 1 ppm.
The filters remove 175 - 33 = 142 ppm
One gallon per million gallons is 1 ppm
8.34 pounds per million gallons is 1 ppm

(8.34 lbs/~~mil gal~~)(15.675 ~~mil gal~~/day)(142) = 18,564 lbs/day

7. 1 MGD = 41,440 GPH = 5540.11 cu ft/hour
1 cubic foot = 7.48 gallons

Since calculation with GPH is easier than cu ft/hour, we will go with the GPH

$$\frac{(52{,}375\ \text{~~cu ft~~})(7.48\ \text{~~gal~~/~~cu ft~~})}{41{,}440\ \text{~~gal~~/hour}} = 9.45 \text{ hours}$$

Note: Using a sliderule, the answer 9.45 will often be erroneously translated as 9 hours 45 minutes.

8. 13 mg/l = 13 ppm
13 ppm = (13)(8.34 pounds/MGD)
1 pound hypochlorite = 0.417 pounds of chlorine

$$\frac{(13)(8.34)\text{ppm}\quad(0.75\ \text{MG/day})}{0.417\ \text{lbs}} = 195 \text{ lbs/day}$$

Complete Solutions to B Problems (continued)

9. **Pounds BOD = (MGD flow)(8.345)(ppm)(BOD)**
625 = 5.5 x 8.345 x ppm
ppm = 625/(5.5 x 8.345) = 13.617298

The oxygen provided by the stream
(13.617)(5.5) = 74.895

The oxygen left for use
181.7 - 74.895 = 106.805

The new flow
23 MGD + 5.5 MGD = 28.5 MGD

The calculated dissolved oxygen
106.805/28.5 = 3.7475438 ppm

10. Solids in sample = 42.37 g - 36.97 g = 5.40 g
Sludge sampled = 95.83 g - 36.97 g = 58.86 g

(a) $\frac{5.40 \text{ g}}{58.86 \text{ g}} = 0.0917 = 9.17\%$ solids

Volatile solids = 42.37 g - 39.26 g = 3.11 g

(b) Percent volatile solids = $\frac{3.11 \text{ g}}{5.40 \text{ g}} = 0.576 = 57.6\%$

11. (a) Suspended solids = 35.3695 g - 35.3268 g = 42.7 mg

(b) Volatile solids = 35.34479 - 35.3298 g = 0.0149 g = 14.9 mg

(c) Non-volatile = $\frac{42.7 \text{ mg} - 14.9 \text{ mg}}{42.7 \text{ mg}} = 0.651 = 65.1\%$

Complete Solutions to B Problems (continued)

12. (a)

Mon	Tues	Wed	Thur	Fri	
802	665	533	380	242	137
-665	-533	-380	-242	-108	132
137	132	153	138	134	153
					138
					134
					694 lbs

$\frac{694 \text{ lbs}}{5} = 138.8 \text{ lbs}$

(b) The pounds of chlorine needed to achieve a 1 ppm residual is:

$$\left(\frac{1 \text{ lb Cl}}{1{,}000{,}000 \text{ lbs water}}\right)\left(\frac{8.34 \text{ lbs water}}{\text{gal}}\right)(5{,}900{,}000 \text{ gal/day}) =$$

49.2 lbs Cl/day

The chlorine demand is computed as the difference between chlorine applied and the chlorine residual:

138.8 lbs - 49.2 lbs = 89.6 lbs

13. (a)

July 1st				July 2nd			
min	hour, tenths	gals	total	min	hour, tenths	gals	total
30	$\frac{30}{60}$=0.5	2725		30	$\frac{30}{60}$=0.5	2725	
36	$\frac{36}{60}$=0.6	3270	5995	24	$\frac{24}{60}$=0.4	2180	
				12	$\frac{12}{60}$=0.2	1090	5995

(b) The sequence of intake stroke and exhaust stroke effect one unit displacement of sludge, therefore, revolutions equal number of discharges of sludge.

$$\left(\frac{545 \text{ gals}}{0.1 \text{ hr}}\right)\left(\frac{0.1 \text{ hr}}{6 \text{ min}}\right)\left(\frac{\text{min}}{50 \text{ rev}}\right) = \frac{1.82 \text{ gal}}{\text{rev}}$$

Complete Solutions to B Problems (continued)

13. (c) $(1.82 \text{ gal}) \frac{\text{cu ft}}{7.5 \text{ gal}} = 0.24 \text{ cu ft}$

$(0.24 \text{ cu ft}) \frac{1728 \text{ cu in}}{\text{cu ft}} = 414.7 \text{ cu in}$

Volume displaced = bore (area) x stroke (height)

area of cylinder = $0.785 (d)^2$

$0.785 (9")^2 = 63.6 \text{ sq in}$

$414.7 \text{ cu in} / 63.6 \text{ sq in} = 6.5 \text{ in}$

14. Volume = (32 ft)(32 ft)(21.5 ft) = 22,016 cu ft

Volume per capita = $\frac{22{,}016 \text{ cu ft}}{20{,}000 \text{ people}} = 1.1 \text{ cu ft/per capita}$